DOT/FAA/RD-90/8

Research and Development Service
Washington, D.C. 20591

AD-A231 235

Analysis of Helicopter Mishaps at Heliports, Airports, and Unimproved Sites

Research and Development Service
Federal Aviation Administration
Washington, D.C. 20591

January 1991

Final Report

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

U.S. Department of Transportation
Federal Aviation Administration

NOTICE

Technical Report Documentation Page

Report No. DOT/FAA/RD-90/8	2. Government Accession No.	3. Recipient's Catalog No.
Title and Subtitle: Analysis of Helicopter Mishaps at Heliports, Airports, and Unimproved Sites		5. Report Date: January 1991
		6. Performing Organization Code
Author (s): L. D. Dzamba, R. J. Hawley, R. J. Adams		8. Performing Organization Report No. SCT No. 90RR-46
Performing Organization Name and Address: Systems Control Technology, Inc. 1611 North Kent Street, Suite 910 Arlington, Virginia 22209		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. DTFA01-87-C-00014
2. Sponsoring Agency Name and Address: U.S. Department of Transportation Federal Aviation Administration 800 Independence Avenue, S.W. Washington, D.C. 20591		13. Type Report and Period Covered: Final Report
		14. Sponsoring Agency Code: ARD - 30

5. Supplementary Notes

ARD - 30 Vertical Flight Program Office

16. Abstract

A task was undertaken to determine possible inadequacies in FAA design standards and guidelines set forth in the Heliport Design Advisory Circular (AC 150/5390-2). This report is based upon the results of an analysis of helicopter mishaps which occurred within a 1 mile radius of various landing sites, including heliports, airports, and unimproved sites. NTSB and U.S. Army reports describing mishaps that occurred at or near a facility were used. The focus of the analysis was to determine the manner in which facility design may contribute to mishaps. Particular attention was given to issues concerning the size, obstruction clearance, and adequacy of facility protected airspace and operational areas. Mishap type and location, as well as the applicable design issues, were analyzed from the reports and are discussed.

This study concludes that overall, the Heliport Design Advisory Circular provides very good guidelines for heliport design and is a valid instrument. Several areas for possible improvement within the document have been identified. Recommendations include areas addressing obstruction marking, facility maintenance, wind indicator location, and guidelines for operations at airports.

This report is one in a series of three dealing with rotorcraft accidents at heliports, airports, and unimproved helicopter landing sites. The other reports are:

"Analysis of Helicopter Accident Risk Exposure at Heliports, Airports, and Unimproved Sites," DOT/FAA/RD-90/9, and
"Composite Profiles of Helicopter Mishaps at Heliports and Airports," DOT/FAA/RD-91/1.

7. Key Words: Airport, Helicopter, Heliport, Mishap, Safety, U.S. Army	18. Distribution Statement: This document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

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PREFACE

The research effort herein was managed by the Federal Aviation Administration (FAA) Vertical Flight Program Office (ARD-30) under contract to Systems Control Technology (SCT), Air Transportation Systems Division, Arlington, VA. SCT was assisted in this effort by Advanced Aviation Concepts (AAC) of Jupiter, Florida. Two of the authors, Mr. Len Dzamba and Mr. Robert Hawley are with SCT. Mr. Richard Adams is employed by AAC.

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1.0 INTRODUCTION

1.1 PURPOSE

Advisory Circular 150/5390-2 (reference 1), entitled "Heliport Design," provides design guidelines, recommendations, and standards for heliports, helistops, and helipads, as well as for helicopter facilities at airports. The advisory circular* addresses a number of areas, to include parking area separation, protected airspace requirements, lighting, surface characteristics, wind indicators, etc. Only Federally funded heliports are required to adhere to these guidelines. As a result, a variety of heliport designs, employing various design parameters, may be found in operation today.

Mishap** data was analyzed in this effort and was intended to be used for two purposes. The first of these was to:

- gain an understanding of the types of mishaps that occur on and near heliports,
- determine if current heliport design requirements are adequate based upon mishap analysis, and
- make recommendations concerning areas in the Heliport Design Advisory Circular which may need to be addressed, expanded, or emphasized.

The second purpose of the analysis was to quantify the risk associated with heliport operations, and to develop a methodology for comparing helicopter accident statistics with corresponding fixed-wing general aviation, commuter, and air carrier operations. The results of these efforts are presented separately, with risk exposure being addressed in a companion report entitled "Analysis of Helicopter Accident Risk Exposure at Heliports, Airports, and Unimproved Sites," DOT/FAA/RD-90/9.

1.2 BACKGROUND

Current helicopter operations occur at a variety of facilities including public and private heliports, airports, offshore oil platforms, and improved as well as unimproved landing sites. Pilots are faced with numerous heliport designs and operational considerations depending upon the type of construction, location, and intended use of the facility. Several factors that may vary from facility to facility include the size of the approach/departure protected airspace, landing area surface composition, obstruction clearance, refueling availability and type, ground and obstruction markings, overall facility size, and facility layout.

*NOTE: This report addresses the Heliport Design Advisory Circular [AC 150/5390-2] and will refer to this advisory circular throughout as "advisory circular" or "Heliport Design AC."

**NOTE: The term mishap is used to denote either an accident or an incident.

Several research and development projects have been undertaken to quantify various aspects of heliport design as it relates to helicopter performance. These include:

- o "Heliport Surface Maneuvering Test Results," DOT/FAA/CT-TN88/30, (reference 2),
- o "Heliport VFR Airspace Based on Helicopter Performance," DOT/FAA/RD-90/4, (reference 3),
- o "Helicopter Physical and Performance Data," DOT/FAA/RD-90/3, (reference 4),
- o "Helicopter Rejected Takeoff Airspace Requirements," DOT/FAA/RD-90/7, (reference 5),
- o "Evaluating Wind Flow Around Buildings on Heliport Placement," DOT/FAA/PM-84/25, (reference 6), and
- o "Rotorcraft Acceleration and Climb Performance Model," DOT/FAA/RD-90/6, (reference 7).

These undertakings were concerned with the requirements and adequacy of heliport protected airspace, parking and maneuvering separation, rejected takeoff ground/airspace, and wind flow analysis as they relate to current heliport design guidelines and actual helicopter performance. In addition to those mentioned above, a current research effort is endeavoring to understand and model the dynamics of rotorwash. A number of these projects have recommended that one or more of the current heliport design standards be revised or revisited. However, before making any changes to the advisory circular, it was recognized that a review of the historical mishap database should be undertaken to understand the nature of mishaps that have occurred or may have a high probability for occurrence at heliports. This report presents the results of that analysis.

Because the term "heliport" may be interpreted differently and may include various types and locations of facilities, the term "heliport," as it applies to this study, is defined as any facility that is designated a heliport, whether stand-alone or at an airport, and any location for which the obvious intended use is as a heliport. For instance, a barge, parking lot, or even an individual's backyard that was used regularly for helicopter operations was considered a heliport. On the other hand, a location which is used as a takeoff/landing area only once or twice was placed in the "other" facility category. This definition is generally consistent with the following definition which is contained in the Heliport Design AC.

> "A heliport is an identifiable area on land, water, or structure, including any building or facilities thereon, used or intended to be used for the landing and takeoff of helicopters."

Offshore oil-platform mishaps were intentionally excluded from this analysis, since offshore landing facilities are not addressed in the Heliport Design AC and are not normally available for public use. Offshore oil platform design for helicopter use is addressed in a separate document entitled "Offshore Heliport Design Guide," reference 8. This document is published by the Louisiana Department of Transportation and Development and is accepted as the industry standard.

1.3 DOCUMENT USE

The primary focus of this study was to review design-related mishaps which have occurred at or within 1 mile of heliports (throughout this document we will refer to such mishaps as taking place "near" heliports, airports, or unimproved sites). However, early in the study it was realized that there were relatively few such mishaps which occur near heliports and very few which occur near public use heliports. Therefore, in order to obtain enough information to examine design-related mishap causes, it was necessary to include mishaps which have occurred near airports as well as unimproved sites. Of the 117 civil and military mishaps used in the study, 4 mishaps (3 percent) occurred near public use heliports, 41 (35 percent) occurred near private heliports, 41 (35 percent) occurred near airports, and 31 (27 percent) occurred near unimproved landing sites.

By reviewing design-related mishaps, potential design related shortcomings can be understood and measures can be taken to further reduce the already low number of such occurrences. It is hoped that by looking at the types of mishaps that may occur near heliports, airports, and unimproved sites, this document will be used by heliport and airport designers to assist them in their facility design efforts.

Also included in this document are discussions of operational factors that have contributed to several of the mishaps. These discussions highlight the importance of good operational procedures. These operational procedures are not necessarily related to design issues but do contribute to a safer heliport environment. Discussion relating to operational cause factors can be used by pilots and flight instructors to help understand the role operational factors may have in causing mishaps.

This document can be used both for training and for risk management analysis. The intended audience includes heliport designers, heliport operators, flight instructors, and pilots.

2.0 METHODOLOGY OVERVIEW

The basic methodology used for this study is depicted in figure 1.

2.1 DATABASE SEARCH AND DATA COLLECTION

The initial effort was to collect helicopter mishap summaries. To ensure that all operators and types of operations using public and private facilities were included, mishap summaries were solicited from both civil and military sources. Mishap summaries were received from the National Transportation Safety Board (NTSB) and the United States Army. Once the mishap summaries were reviewed, full reports for those mishaps deemed appropriate to the study were ordered for in-depth analysis.

2.2 IN-DEPTH ANALYSIS

An in-depth analysis of each full mishap report was then performed. Particular attention was given to dimensional, surface, and protected airspace issues. These factors were of particular importance, since they represent the basic characteristics of heliport design and comprise the primary focus of the Heliport Design AC.

2.3 ADVISORY CIRCULAR RECOMMENDATIONS

Based upon the analysis, areas of the Heliport Design AC requiring revision, expansion, or increased emphasis were identified and, where supporting data was available, recommendations for change were made.

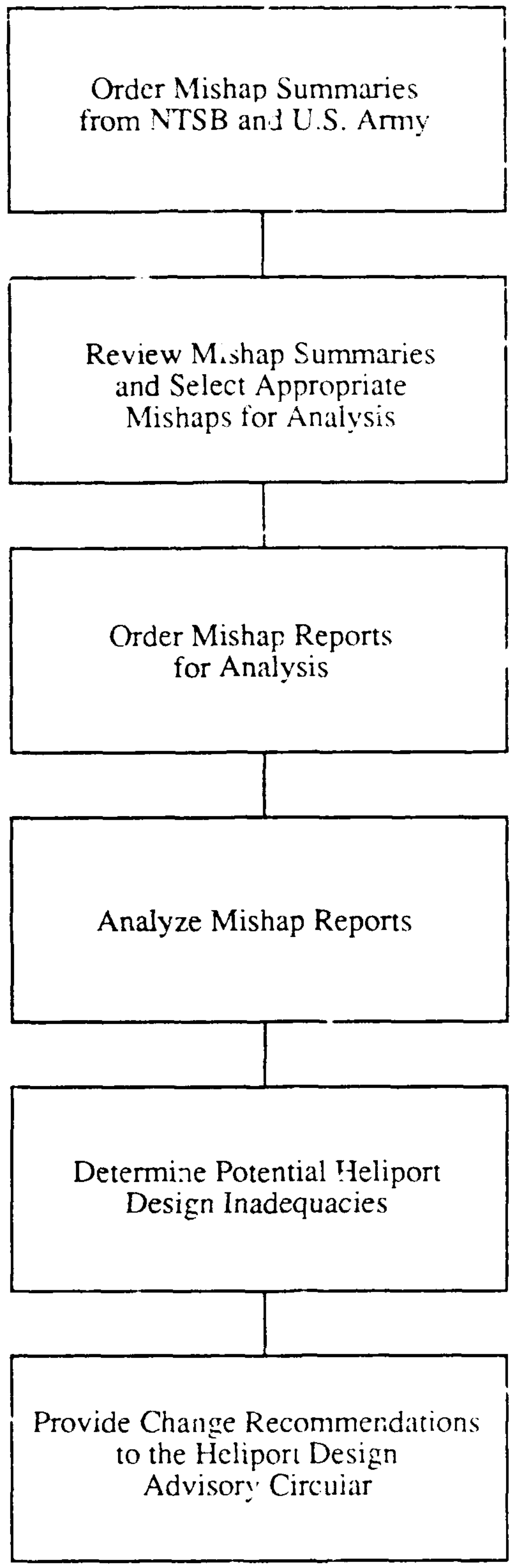


FIGURE 1 METHODOLOGY FLOWCHART

3.0 MISHAP DATABASE SEARCH

3.1 DATA COLLECTION

In order to assure a level of completeness and accuracy, it was deemed desirable to include a minimum of 100 heliport mishaps in the in-depth analysis. At the start of this effort the number of helicopter mishaps contained in the civil mishap database, as well as the quantity and quality of data available, was unknown. It was therefore decided that mishap reports from both civil and military sources would be used. Although the missions of the two groups differ significantly, their respective operations on or about heliports are principally the same. In fact, many military operations do occur at civilian facilities. None of the selected military mishaps included operations that were unique to military missions near the landing site. For example, missions that may have required nap-of-the-earth (NOE) flying near the landing facility were not included.

To ensure that the full spectrum of mishaps that occurred at or near a landing site would be considered for the study, mishaps over a 22 year period from 1964 through 1986 were initially included. While the type, quality, and completeness of both civil and military mishap reports over this broad range of years was uncertain, any narrowing of the source data could only be considered after the available data set was known.

Data sources used in this study were limited to United States government agencies. This was done for several reasons, the most basic being that the Heliport Design AC is written for U.S. helipc 's and airports. In addition, the type, quality, availability and timeliness in receiving international mishap reports was highly uncertain. This uncertainty was thought to be an inappropriate burden to the study.

3.1.1 <u>Civil Mishap Data Source</u>

Mishap reports and statistics for civil mishaps in the United States are recorded and maintained by the National Transportation Safety Board (NTSB) in Washington, D.C. The NTSB was contacted, and a request was made to obtain a copy of each factual report and mishap summary for helicopter mishaps occurring from 1964 through 1986. The Heliport Design AC provides guidelines for protected airspace out to 4,000 feet from the edge of the takeoff/landing area of a heliport. It was therefore desirable to review those mishaps which occurred both on and within 4,000 feet of the heliport. The request to the NTSB stipulated that only mishaps that occurred on or within one mile of a heliport be included. The criterion of "within 1 mile" was used as a selection device because it is the nearest division to the advisory circular's 4,000 feet that the NTSB has used for mishap location in their reports. The study reviewed mishaps that took place within 1 mile and selected for further review only those that appeared to be related to heliport design issues.

NTSB mishap forms were revised several times throughout the period considered. One of the items significant to this study that has changed several times on the mishap report form is the recording of the distance from the landing site that the mishap occurred. Figure 2 shows how this information has been recorded and how this recorded information has

AIRPORT INFORMATION

Airport Proximity | Column 31 | Card No. 02

Code

A - On Airport

B - On Seaplane Base

C - On Heliport

D - On Barge/Ship/Platform (helicopter only)

E - In Traffic Pattern

F - Within 1/4 mile)

G - Within 1/2 mile)

H - Within 3/4 mile)

I - Within 1 mile)

J - Within 2 miles) Measured to nearest runway of the airport, private strip or prepared landing area.

K - Within 3 miles)

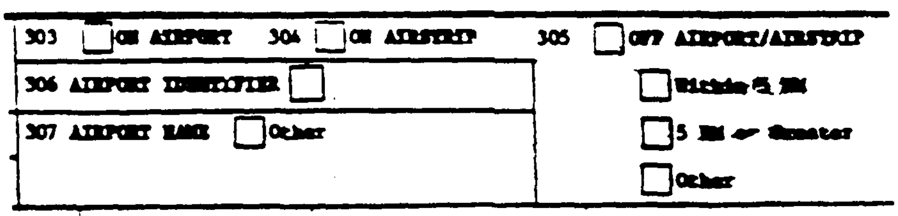
L - Within 4 miles)

M - Within 5 miles)

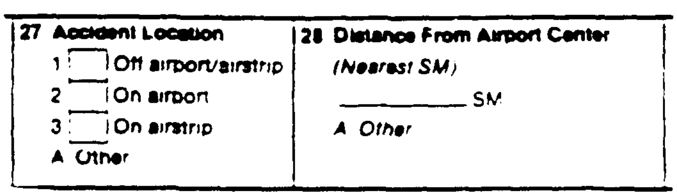
N - Beyond 5 miles)

Z - Unknown/Not Reported

1978-1981 Format



1982 Format


27 Accident Location
1 Off airport/airstrip
2 On airport
3 On airstrip
A Other
28 Distance From Airport Center
(Nearest SM)
_______ SM
A Other

1983-19[illegible] Format

FIGURE 2 MISHAP LOCATION INFORMATION (NTSB MISHAP FORMS)

changed over the years. The 1982 factual report records location as being within or outside 5 statute miles of the airport, a drastic change to the 1/4 mile accuracy previously required. In more recent years the factual report form has recorded the distance to the nearest statute mile. Also of note in this data field is that prior to 1982 the term "heliport" was included on the mishap form.

Supplemental forms for use in mishap investigations were made available to NTSB investigators beginning in 1983. These forms contain additional information which is not included on the primary factual report form. In particular, supplement G (appendix A) entitled "Rotorcraft" contains information about the aircraft which is exclusive for rotorcraft purposes. Supplement Q (appendix B) entitled "Airport/Airstrip" contains information concerning the facility and any obstacles (wires, trees, towers, etc...) surrounding the facility. This supplement also contains information concerning the distance from the facility that the aircraft came to rest after an off-facility forced landing. Although these forms are available to investigators, only five percent of the civil mishap reports used in the in-depth analysis included supplement Q and only 25 percent included supplement G.

Since the desired data consisted of mishaps on or within 4,000 feet of a heliport, all mishaps occurring within 1 statue mile of a heliport were requested. In many instances subsequent analysis would show that the exact location of a mishap could not be determined to a finer degree than a statute mile, even when the detailed mishap report was provided.

3.1.2 Military Mishap Data Sources

All branches of the United States military were contacted, and mishap data were requested from each. The U.S. Army ultimately provided approximately half of the accident/incident reports which were used in the in-depth analysis portion of the study. The U.S Navy did provide access to mishap reports. However, the number of mishap summaries the Navy provided was very limited and were ultimately determined not to be appropriate to the study.

The U.S. Air Force and the U.S. Coast Guard stated that they had very few helicopter mishaps in their database. They also stated that the mishaps that they did have would not apply to our efforts. Therefore, neither agency provided mishap data for the study.

It is important to note that the mishap request to the Army was made under the Freedom of Information Act (FOIA). The Army was most cooperative and provided the releasable portion of each full mishap report. However, investigative board findings and recommendations are not releasable under FOIA and were not provided by the Army. The extent to which this tended to limit the information provided and to what degree this may have affected the mishap analysis is unknown.

3.2 MISHAP SUMMARIES

Mishap summaries for the years 1964 through 1986 were requested from the NTSB. However, it was soon learned that the NTSB does not retain full mishap reports for a period of more than 10 years in the case of general aviation mishaps and for a period of 15 years for air carrier

mishaps. Air carrier mishap reports which are older than fifteen years are archived in the Library of Congress; general aviation mishap reports are not. Since there are very few helicopter air carrier mishaps, only full mishap reports dating back to 1978 were used. Also, prior to September 1988, mishaps involving public use aircraft were not required to be reported to the NTSB. These reporting requirements changed in 1988 as a result 49 CFR Part 830 (reference 9). The above factors narrowed the focus of the study, at least on the civil side.

The NTSB provided 1,428 mishap summaries for the years 1978 through 1986, samples of which are provided in figure 3. This included 26 mishap summaries from 1978 through 1981 and 1,402 summaries for 1982 through 1986. The large disparity for the two groups arose because the 1978 through 1981 group included mishaps which occurred only at heliports, while the 1982 through 1986 group included all helicopter mishaps, irrespective of landing facility or phase of flight.

The intent of the study had been to review only <u>accident</u> data. However, the reports that were used for the final in-depth analysis differed in that while the civil data included only accidents, the military data included both accidents and <u>incidents</u>. An accident, in civil terms, is defined in part as an occurrence incidental to flight that results in substantial damage to an aircraft or serious injury to a person. The military differentiation between accidents and incidents and their system of mishap classification is explained in section 3.2.2. Because accidents as well as incidents were used in the analysis this report will refer to them both as a mishap.

The U.S. Army provided approximately 3,000 mishap summaries for the years 1972 through 1986. A sample of Army mishap summaries is provided in figure 4.

3.2.1 NTSB Mishap Summaries

The NTSB provided mishap summary data in three separate groups depending upon the year the accident occurred. This was done because the accident investigator's report forms had changed three times during the years of interest to the study and the data was catalogued differently during these periods.

The three separate groups included the years:

- 1964 through 1981,
- 1982, and
- 1983 through 1986.

The data available in each group of accidents varied and will be discussed below.

3.2.1.1 1964 Through 1981

The NTSB provided a copy of the investigator's "Aircraft Accident Analysis Sheet" for each helicopter mishap from 1964 through 1981, a sample of which is provided in appendix C. This information was provided by NTSB on magnetic tape and had to be accessed and analyzed via computer. It is important to note again that because full mishap reports

The aircraft had just discharged two passengers on the rooftop helipad and was preparing for departure. The aircraft was picked up to a hover and the tailrotor struck a heliport surface perimeter light. The tailrotor separated from the aircraft and the aircraft rotated to the right. Throttles were reduced to stop the rotation and the aircraft settled back down to the helipad. The aircraft bounced side to side and rolled off the helipad and came to rest on its left side. The pilot exited and extinguished a small fire that had started near the engine exhaust.

While hovering from the wash rack, the helicopter backed into a utility pole. The main rotor system separated from the airframe following the collision. There were no postimpact mechanical malfunctions/failures.

During ground refueling of the aircraft the fuel tank was over-filled and the fuel spilled over onto the ramp. The fuel was ignited and the aircraft was destroyed by fire.

The pilot was on a mission to transport company personnel and had landed on a barge that was being used as a helipad. The barge was about 250 feet long and 75 feet wide. After arriving, the pilot parked the helicopter with the tail boom as close to the edge of the barge as possible. He then reduced the power to idle and signaled for the three passengers (waiting behind a rope line) to approach the helicopter in accordance with established procedures. As the passengers approached the right side of the helicopter, they moved out of the pilot's line of sight. While two were boarding, the third passenger walked to the rear of the aircraft, ducked under the horizontal stabilizer and walked into the tail rotor. The victim was taken to a hospital, but succumbed later due to head and shoulder injuries. A training program had been instituted to educate the passengers concerning hazards associated with rotating components of the rotor system and off-limit areas. The passenger had been briefed on three occasions and had been a passenger nearly every day for six weeks.

Aircraft was parked with 3 feet clearance between main rotor and corner of hangar. Pilot stated that on liftoff a gust of wind blew aircraft toward hangar. Main rotor blades made contact. Ground crewman injured by flying debris.

The helicopter collided with a pole and landed hard during air taxi to position the aircraft. The pilot had just off loaded passengers and was alone in the helicopter. A witness said the pilot hovered too close to the pole and both rotor blades made contact. The pole that was struck was severed about 12 feet AGL.

FIGURE 3 NTSB MISHAP SUMMARIES

Rotor wash from departing acft caused main rotor of parked acft to flex down and hit tail rotor drive shaft cover. Parked acft main rotor blade was secured by aft blade only. Excessive rotor wash was caused by close proximity of parked aircraft. This was due to unsuitability of available parking at AHP. Crews and maintenance personnel were directed tc insure that two M/R tie-downs (one fwd and one aft) be used on all acft allowing adequate separation between the main rotor and tail boom.

A/C was taxing behind a parked acft when the left hand side of the rotor system struck a tail rotor blade on the parked acft.

Following refuel at civ airport, aircraft was picked up to hover and moved right to clear POL pit area. After moving approx. 30 feet, loud bang heard and aircraft made immediate roll to right impacting right skid on ground. Inspection revealed refuel grounding wire still attached to right skid. Aircraft evacuated to home station by recovery team for technical inspection!

A/C terminated a normal approach to a lighted helipad. While performing a PMD insp on parked acft, the CE left the pilot's door unlatched. The rotor wake (wind) from landing acft opened door hinges to damage the doorpost mount and shatter the right chin bubble. Parking area was less than 120 feet from helipad. Parking was relocated. GM failed to follow unit SOP while completing duties during PMD.

Aviator was hovering aircraft to parking position when tip of rotor blade struck an angle iron protruding approximately seven feet out from hangar building.

Acft was being four wheel taxied off the runway for parking. While taxing the aft rotor blades hit a wooden lighting pole located on the perimeter of the parking area.

Pilots were attempting to aft wheel taxi the aircraft backward in an effort to avoid possibly damaging the flight controls of a small jet which was located directly ahead of the aircraft. The aircraft became airborne while attempting to taxi backward and moved approximately 19 feet to the left resulting in the aft rotary wing blades striking a large metal sign pole. The aircraft was landed and engines secured.!!

Aircraft was damaged during day landing to a sloped, unprepared refueling area at a civil airport. Front of the skids touched down initially with nose pointed into the slope, aircraft rocked back, became airborne and moved forward 30 feet and landed hard with the left aft skid resting on a concrete marker which protruded approximately one inch above the ground.

FIGURE 4 U.S. ARMY MISHAP SUMMARIES

for mishaps prior to 1978 were not available, summaries for mishaps prior to 1978 were not considered. Mishap summaries for mishaps occurring between 1978 and 1981 were not available on the magnetic tape provided by the NTSB, which necessitated a separate request for printed summaries for that period. The NTSB provided a small number of mishap summaries for the period of concern. This number included only those mishaps which were determined to have occurred at heliports. Since whether or not a mishap occurred at a heliport could not always be determined from the investigator's report form or the mishap summary, it is not certain that all of the heliport mishaps that occurred during this time period were included in the mishap summaries provided by NTSB.

3.2.1.2 1982

The preliminary data obtained for the year 1982 were provided on magnetic tape in three separate computer files. The files contained the following data for each accident:

- o factual report,
- o mishap summary. and
- o cause and factors listing.

A sample of the investigator's report form is presented in appendix D. This was basically "fill in the blanks" type information. Information provided in the report form includes date, time, and location of the mishap, as well as items concerning the aircraft, pilot, passengers, and selected information relevant to the mishap.

The mishap summary file is a narrative file that contains a brief summary of each mishap. These summaries were similar to those presented in figure 3. The 1982 mishaps for which full mishap reports were ordered were selected primarily based upon these summaries.

The cause and factors file contained data concerning the principal and contributing cause and factors for each mishap. This file was relative to the design issues under study.

As previously mentioned, all three files for each mishap were provided on magnetic tape. These files were downloaded onto 5 1/4" floppy disks for use on personal computers. Computer programs were then written to retrieve the desired information.

3.2.1.3 1983 Through 1986

Data provided by the NTSB for these years were again presented in three separate files on magnetic tape. These data were very similar to that provided for 1982; however, the investigator's report form used from 1983 through 1986 differed from that used in 1982 (see appendix E). As in the case of the 1982 data set, full mishap reports were ordered based primarily upon the mishap summary files.

3.2.2 Military Mishap Summaries

A written request for U.S. Army mishap information was made to the U.S. Army Safety Center at Fort Rucker, Alabama. Fort Rucker is the primary repository for Army aviation mishap reports and statistics.

Mishap summaries and supporting information for all helicopter mishaps occurring within 1 mile of a heliport were requested. The Safety Center provided Class A through Class D mishap summaries for 1972 through 1986.

The U.S. Army categorizes aviation mishaps in five different classes: A through E. Mishaps are categorized according to the total dollar amount of damage and/or the severity of injuries. In the past the Army has updated the criteria for each class several times. Therefore, the dividing line between mishap class has periodically changed throughout its use. Current criteria (since October 1, 1988) for categorizing Army mishaps for Classes A through E are given below.

Class A:
- total value greater than or equal to $1,000,000, or
- aircraft missing, destroyed, abandoned, uneconomically repairable, or
- at least one fatality, or
- a permanent totally disabling injury.

Class B:
- total value greater than or equal to $200,000 but less than $1,000,000, or
- a permanent partially disabling injury, or
- hospitalization of five or more personnel in a single occurrence.

Class C:
- total value greater than or equal to $10,000, but less than $200,000, or
- a loss of at least one workday.

Class D:
- total value greater than or equal to $2,000, but less than $10,000, or
- loss of workday case involving one or more days of restricted work activity, or
- a non-fatal case without a lost workday or medical treatment.

Class E:
- total value less than $2,000.

The Army categorizes Class A, Class B, and some Class C mishaps as accidents; some Class C, all Class D, and all Class E mishaps are classified as incidents.

3.3 MISHAP SELECTION

In order to select the mishaps that would ultimately be used in the study, the written civil and military summaries of each mishap were reviewed and, based on these reviews, full mishap reports were ordered for in-depth analysis. The brevity of the information contained in the summaries makes mishap selection difficult and could result in ordering mishaps that were not appropriate or, conversely, failing to order mishaps which may be appropriate to the study. For this reason, it was decided that more than 100 full mishap reports would be ordered with the expectation of rejecting a number of these once they were reviewed. The principal criteria used when selecting mishaps was as follows:

- o mishaps occurring on or within 1 mile of a heliport (not to include offshore oil platforms),

- o mishaps that may have been associated with the visual flight rules (VFR) approach/departure protected airspace corridor,
- o mishaps that may have been associated with the clear zones immediately adjacent to the heliport,
- o mishaps not otherwise identified but occurring on a landing facility, and
- o rotorwash mishaps.

Although the summaries did provide a brief account of each mishap, in many instances the summaries did not provide sufficient information for determining applicability to the study. In particular, it was difficult to ascertain whether the mishap occurred within a mile of a heliport, or, whether the particular facility in use was in fact a heliport, airport, or "other" type of facility. In some instances, additional information contained in the supporting NTSB investigator's report form provided answers. Information provided by the military, however, did not have accompanying data which required mishap selection to be based upon the summaries alone.

Mishap summaries did not always adequately describe the cause of the mishap. For example, in one of the mishap summaries the cause was listed as an undetermined power loss on takeoff. However, when the full mishap report was received it clearly indicated that the actual cause of the mishap was engine failure resulting from a faulty component that was supposed to have been replaced prior to the flight.

To ensure that at least 100 usable reports would be available for the in-depth analysis, a total of 167 full mishap reports were ordered from the NTSB and the U.S. Army. Review and analysis of these mishap reports are addressed in section 4.0.

4.0 IN-DEPTH ANALYSIS

The in-depth analysis consisted of analyzing civil and military full mishap reports. Of primary importance in analyzing these reports was understanding facility design factors which contributed to each individual mishap. Therefore, to a great extent the results, conclusions, and subsequent recommendations for this study hinged upon the quantity and quality of information contained in the full mishap reports. The information contained in these reports depends upon several factors. For instance, the type of operation in which the aircraft was involved at the time of the mishap may determine the extent of the mishap investigation and thereby the completeness of the final mishap report. Air carrier mishaps are typically the most intensely investigated civilian mishaps. Consequently, air carrier mishap reports are usually the most comprehensive, containing more details and information than non-air carrier reports. Additional factors which may affect the amount of information in a mishap report include the skill and experience of the on-site investigator/team, the severity of the mishap in terms of injury and property damage, and the availability of survivors and/or witnesses.

4.1 NUMBER OF MISHAPS

The number of mishaps that were considered in this study and the selection process is depicted in figure 5. The NTSB provided 1,428 accident summaries and the U.S. Army provided 3,000 mishap summaries for review. These summaries included mishaps which occurred during all phases of flight. Consequently, a majority of these mishaps were not appropriate to the study. The full mishap reports were ordered based upon a review of mishap summaries. 167 full mishap reports were ordered based upon this review, 84 from the NTSB and 83 from the Army.

Once received, the full mishap reports were reviewed. A number of these mishaps were found not suitable for this effort. The final number of mishaps used for the study was 117, 17 more than the original target of 100. This included 63 civil and 54 military mishaps. None of the military mishaps that were included resulted from a unique military mission or requirement.

4.2 FACILITY TYPE

The focus of this study was to be heliport mishaps. However, in reviewing the mishap summaries it was not clear in many instances at what type of facility the mishap occurred. When the full mishap reports were analyzed, it was realized that many of the mishaps, while appropriate to the study, had occurred at facilities other than a designated heliport. Figure 5 identifies the number of mishaps which occurred by type of facility. Of the mishaps retained for the study, 45 occurred near heliports, 41 near airports, and 31 near "other" locations. These "other" locations included undesignated, unimproved, remote, and any other location not designated as a heliport or airport. Even though a particular mishap may not have occurred specifically at a heliport, it was nevertheless considered important for the information it provided regarding the types of mishaps that were occurring at landing sites. These mishaps provide insight into various aspects of facility design including information regarding the size of adequate operating air and ground space, type and location of obstructions, the need for protected airspace in approach/departure corridors, and other information pertinent

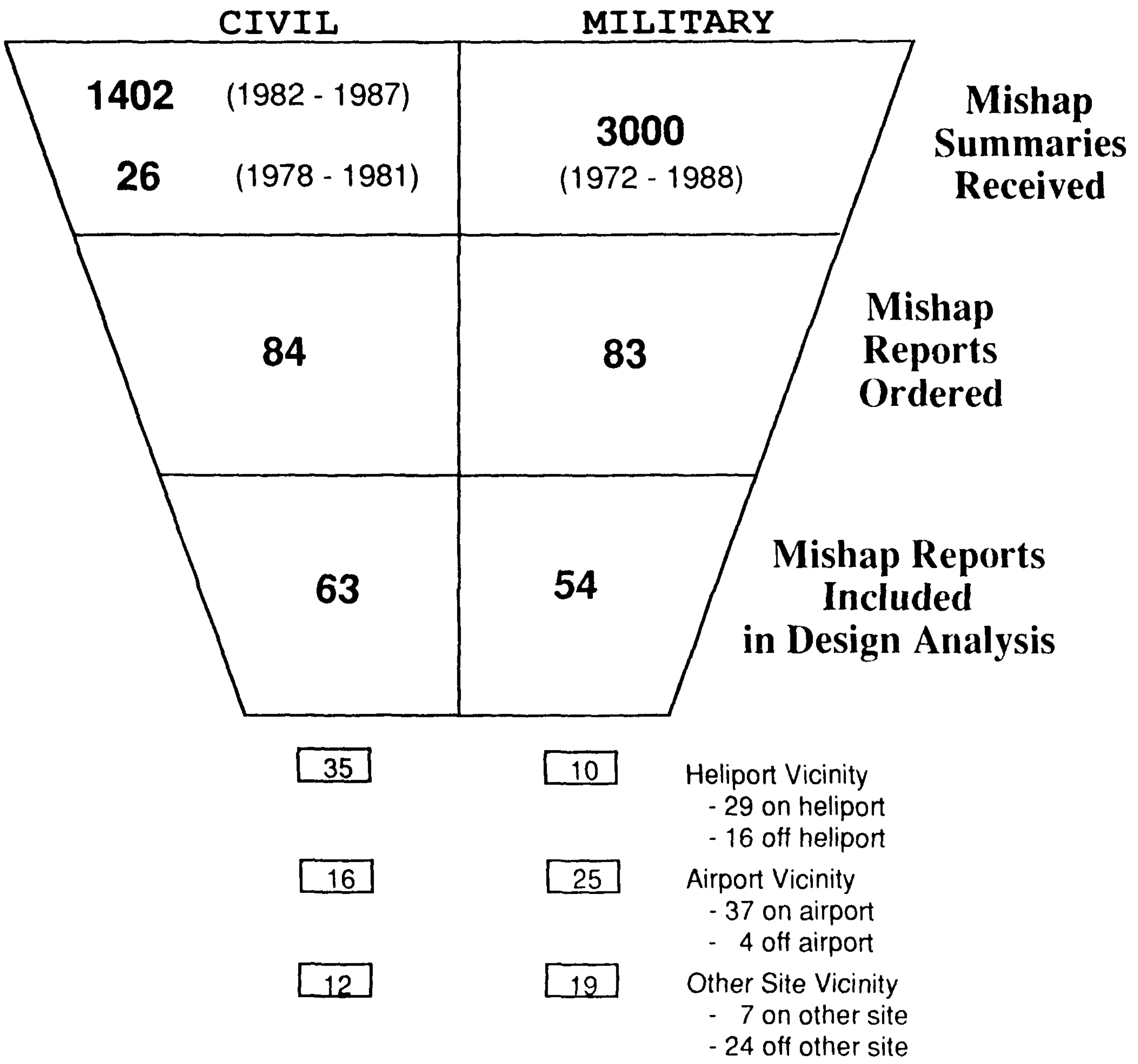


FIGURE 5 MISHAP SELECTION SUMMARY

to heliport design. In many instances (70 percent) the mishaps used for the in-depth analysis occurred at landing sites that employed less stringent design standards than those provided in the Heliport Design AC. This finding suggests that a number of these mishaps may not have occurred had the Heliport Design AC design standards been satisfied at these locations.

4.3 DESIRED DETAILS

Although all aspects of heliport design were considered, issues associated with dimensions specifically addressed in the Heliport Design AC were of primary importance. Specific areas in which detailed information was desired are addressed below.

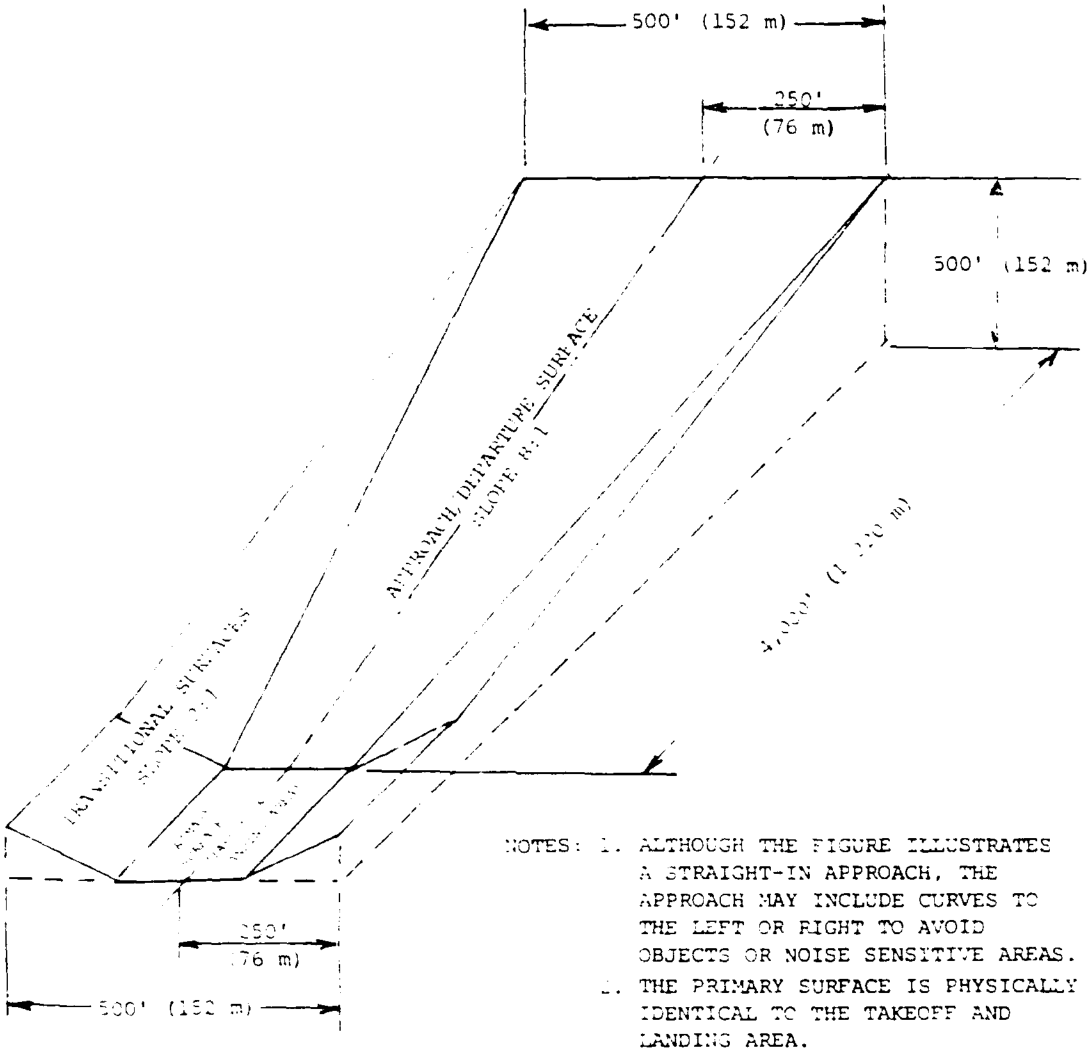
The size of parking spaces, taxiways, and refueling areas were considered highly important and deserving of particular attention. One of the single most important aspects of this study was heliport protected airspace. This not only included the protected airspace surrounding the heliport, but also within the VFR approach and departure corridors. The Heliport Design AC provides guidelines as to the recommended surfaces for heliport VFR protected airspace. These surfaces are depicted in figure 6. The protected airspace begins at the edge of the takeoff and landing area at the width of the primary surface. It rises at a slope of 8:1 and widens to 500 feet at a distance of 4,000 feet. The transitional surfaces begin at the sides of the heliport and have a 2:1 slope.

The length, width, and slope of the protected airspace are critical for several reasons. Principally, they provide obstruction protection not only for the aircraft, but conversely for the structures on and near the heliport. This requirement limits the height of buildings and objects on and near the heliport which may have a direct impact on the surrounding community. It was therefore highly desirable in the analysis to determine exactly where mishaps occurred with respect to the heliport and in relation to the protected airspace.

In a soon to be published report entitled "Helicopter Physical and Performance Data," DOT/FAA/RD-90/3, (reference 4), computer generated departure profiles suggest that current Heliport Design AC protected airspace dimensions may not be adequate for some public heliport operations. Under this study, an analysis of the physical and performance characteristics of several aircraft over a range of operating conditions was conducted to determine approach and departure profiles. Table 1 lists several of the factors considered in the study

TABLE 1
AIRCRAFT AND OPERATIONAL FACTORS

AIRCRAFT	OPERATING CONDITIONS
Aircraft Dimensions	Field Elevation
Weight	Temperature
Takeoff Power	
Helicopter Departure Procedure	



NOTES: 1. ALTHOUGH THE FIGURE ILLUSTRATES A STRAIGHT-IN APPROACH, THE APPROACH MAY INCLUDE CURVES TO THE LEFT OR RIGHT TO AVOID OBJECTS OR NOISE SENSITIVE AREAS.

2. THE PRIMARY SURFACE IS PHYSICALLY IDENTICAL TO THE TAKEOFF AND LANDING AREA.

FIGURE 6 VFR HELIPORT PROTECTED AIRSPACE SURFACES

Using the information in table 1, manufacturer published data, and a computer simulation model, approach and departure profiles for several helicopter models were generated. These profiles illustrated that under some conditions, the 8:1 slope described in the Heliport Design AC may be inadequate. This is especially true for "high," "hot," and "heavy" operations, in which aircraft typically have poorer performance.

It was hoped that critical information such as exact location of a mishap with respect to the heliport, especially for mishaps that occurred off the facility, could be obtained from the mishap reports. In instances of wire strikes, the height and distance at which the aircraft struck the wire, in relation to the heliport, was critical to determining whether or not the aircraft was operating within the recommended protected airspace. Also, forced landings on takeoff mishaps were of great interest, since in some instances they may result in the helicopter dropping below the 8:1 slope. These mishaps included mechanical or material failures, other emergencies, and settling due to insufient power for the operating conditions.

4.4 MISHAP SUMMARY FORM

A mishap summary form (figure 7) was developed to assist in the analysis. This was done in order to collate and standardize as much data contained in the reports as possible. This standardization assisted in the overall analysis, descriptive results, and conclusions of the study. While many of the items included on the mishap summary forms were general details for each mishap, they were deemed important from a trend perspective in the in-depth analysis. Specific items such as time of year, time of day, location, amount of daylight, prevailing weather, etc., when considered for the entire data set, could indicate certain patterns which were not otherwise apparent when considering each mishap separately. Therefore, the in-depth analysis not only focused upon specific design issues, but also included a total overview approach to ensure detection of trends that may not be discernable when considering each mishap separately. Three specific categories that were included on the mishap summary form, and upon which the results of this task are based were:

- o facility mishap location,
- o mishap type, and
- o heliport design issues.

4.4.1 Facility Mishap Location

During preliminary stages of the study and later while reviewing mishap summaries, it became apparent that some method of grouping the mishaps was highly desirable. It was decided that the location where the mishap occurred would serve as a good high-level category for grouping the mishaps. Table 2 contains the various categories in which the mishaps were arranged according to location.

TABLE 2
FACILITY MISHAP LOCATION

TAXIWAY	APPROACH AIRSPACE
PARKING AREA	APPROACH GROUNDSPACE
REFUELING AREA	DEPARTURE AIRSPACE
FINAL APPROACH AND TAKEOFF AREA	DEPARTURE GROUNDSPACE

MISHAP LOCATION

ID NO.	OCCURRENCE INFORMATION DATE	DAY	TIME	LOCATION CITY	STATE	ELEVATION	LOCATION TYPE HELIPORT (H)	AIRPORT (A)	OTHER (O)

MISHAP TYPE

Root Cause (Related Cause)
P=Pilot (DM=Decision Making)
A=Aircraft (M=Mechanical)
E=Environment (W=Wind)
O=Operation (P=Procedures)

HELI TYPE	FLIGHT PHASE	OPERATION TYPE	OPERATING CONDITIONS	HELIPORT DESIGN ISSUES

WEATHER INFORMATION

LIGHT CONDITIONS	CLOUDS (LOWEST) FT AGL	CEILING (LOWEST) FT AGL	VISIBILITY SM	WIND FROM MAG	WIND SPEED KTS	GUSTS KTS	DENSITY ALTITUDE FT

BRIEF DESCRIPTION

FIGURE 7 MISHAP SUMMARY FORM

4.4.2 Mishap Type

The mishap type represents what occurred during each mishap. Those mishaps selected for analysis fell into the following categories:

obstruction strikes (on-facility)	collision with other aircraft
obstruction strikes (off-facility)	insufficient climb angle
power loss on takeoff	power loss on approach
rotorwash	stuck skids
wind indication	refueling

4.4.3 Heliport Design Issues

One purpose of this study was to understand the manner in which heliport design may contribute to helicopter mishaps. Each mishap considered in the in-depth analysis was selected based upon its relationship to a heliport design factor. Heliport design issues identified during the analysis are included in the results section of the report and suggest the basis for the conclusions and recommendations presented.

4.5 NTSB MISHAP REPORTS

The NTSB mishap reports varied in both length and content depending upon factors previously mentioned. Even though specific dimensional details, such as the exact location of an obstruction with respect to the takeoff/landing area were usually not available, the reports did help to identify design factors which contributed to facility mishaps. The reports provided an adequate description of the causes and factors of each mishap, thereby providing insights as to the manner in which heliport design might be a contributor to facility mishaps.

4.6 U.S. ARMY MISHAP REPORTS

The Army mishap reports also varied in both length and content for many of the same reasons as the NTSB reports. The mishap reports for Class A, Class B, and some Class C mishaps varied in length from 25 to over 100 pages and contained substantial amounts of information. The remaining Class C and all Class D reports were typically brief (1 to 10 pages) and did not contain the extensive details of the Class A and B reports.

Table 3 provides a summary of the Army mishaps used for the in-depth analysis by class. It is interesting to note that the majority of facility mishaps occurred in a class (Class D) that represents relatively small monetary losses. However, these mishaps are important in understanding potential facility design related shortfalls. This observation highlights the need for adequate documentation of both accidents and incidents in order to support safety studies. Although an individual mishap may not appear to be related to heliport design, seemingly minor contributing factors may prove to be significant when considered collectively with other mishaps.

TABLE 3
PERCENT U.S. ARMY MISHAPS BY CLASS

CLASS	PERCENT
A	11
B	8
C	24
D	57
E	0

In addition to a mishap report, more severe Army mishaps have an additional report associated with them called a collateral report. Collateral reports are written for legal purposes and may contain additional information not available in the mishap reports. A request was made to the U.S. Army Aviation Systems Command in St. Louis, Missouri to provide collateral reports for selected mishaps used in this study, in hopes of obtaining additional information for those mishaps in which the full mishap report provided few details. However, since collateral reports are used for legal purposes and may contain sensitive material they were not provided by the Army.

As with the NTSB in-depth analysis, the Army analysis was limited due to a lack of information and/or pertinent details in a number of the mishap reports. Therefore, specific design standards and guidelines in the Heliport Design AC such as the dimensions of parking areas, the height, relative distance and the exact placement of required objects on the heliport could not be determined.

5.0 RESULTS

Analysis of the available data from the NTSB and U.S. Army mishap reports highlighted possible heliport design issues which may need to be addressed, expanded, or emphasized in the Heliport Design Advisory Circular. In addition to heliport design issues, the in-depth analysis brought forth several operational issues that contributed in a significant way to several of the mishaps in this study. Since these operational issues contributed to heliport mishaps they will be discussed further in section 5.3. Conclusions and recommendations are presented in section 6.0

5.1 GENERAL FACTORS

Each mishap report contained general information such as date, time, geographic location, elevation, operating conditions (i.e. visual or instrument conditions), and mission type, along with information specific to the mishap. This general information was analyzed to determine if any of these factors pointed to a trend in a significant number of mishaps. After review, it was determined that the time of year, time of day, geographic location, field elevation, operating conditions, and mission type appeared to have had little influence on the group as a whole. In general, the mishaps occurred to a variety of helicopter operators throughout the year, randomly throughout the day, over a range of density altitudes, and across the entire United States. While some of the general factors may have influenced individual mishaps or even several mishaps, no one factor played a major role in the mishaps. Individual mishap analysis yielded the findings as described in the following paragraphs.

5.1.1 Mishap Locations

It was particularly important to understand where, with respect to the facility, mishaps occurred. That is, did the mishap occur in the parking area, the refueling area, on approach or departure, or at some other location on the facility. The location of the mishaps with respect to the facility are presented in figure 8. It is interesting to note that the largest percentage of mishaps occurred in the departure area. This included both departure airspace (e.g. wire strikes) and departure groundspace (e.g. power loss on takeoff) mishaps. The second most frequent location for mishaps was in the parking area. As will be shown later, a large portion of these mishaps occurred at airports. Also of note in figure 8 is that the majority of mishaps that occurred in the approach or departure area occurred off the facility.

As indicated in figure 8, helicopter mishaps may occur anywhere on the facility. Although some locations appear to have a significantly larger portion of the mishaps, no location at a facility appears immune.

5.1.2 Mishap Types

To understand potential design issues, it is necessary to recognize the types of mishaps that are occurring at various facilities. Because of the large number of mishaps used in this analysis, most of the types of mishaps that may occur at heliports are included. It is interesting to note that several of these types of mishaps occur significantly more often than others. This proclivity is the result of several factors, some of which may or may not be related to heliport design.

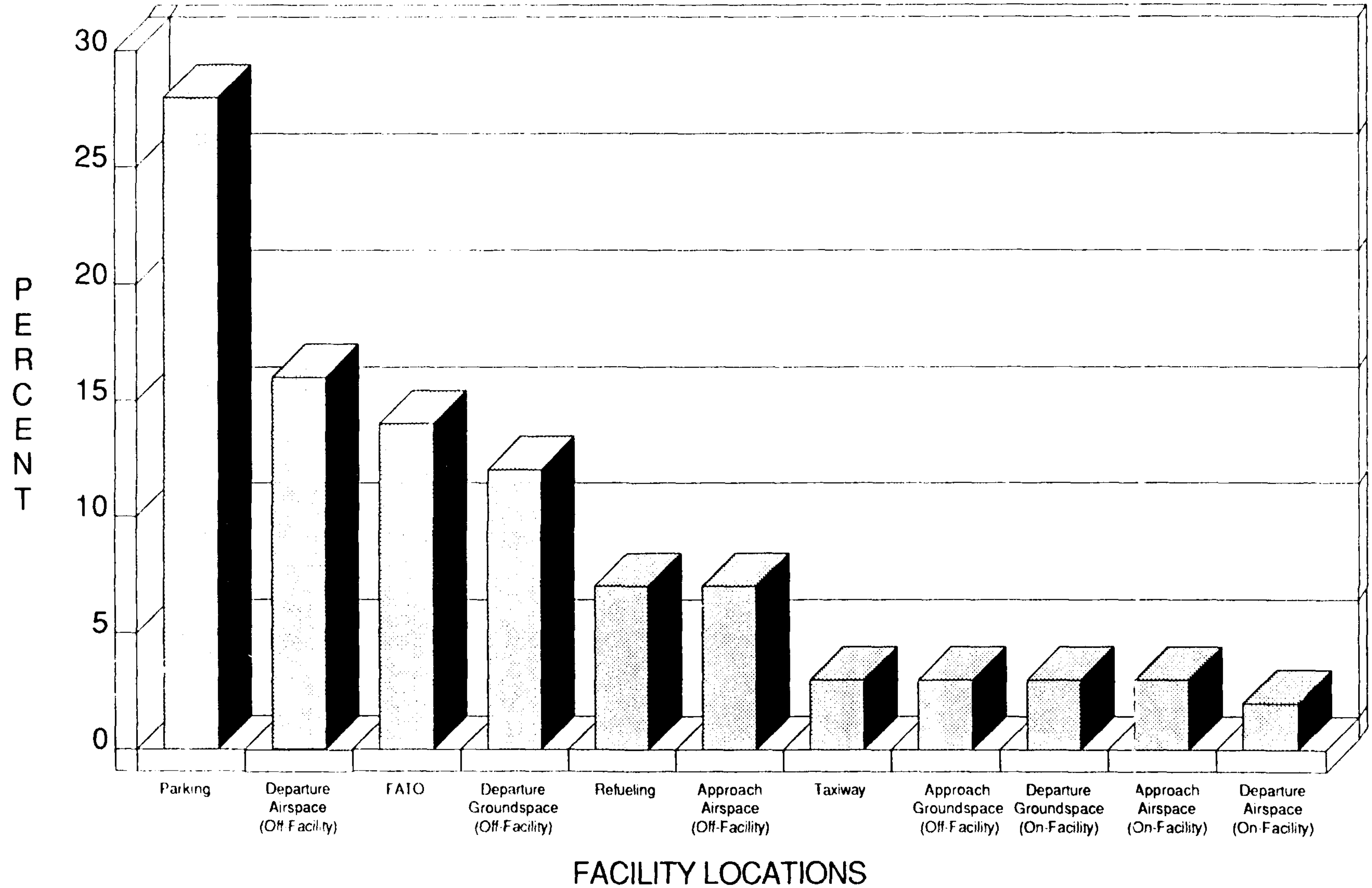


FIGURE 8 FACILITY MISHAP LOCATIONS

A list of the different types of mishaps identified in the study, the facility near which they occurred, and the number of times each occurred is presented in table 4. It is immediately apparent that a wide variety of mishaps occur near heliports. A significant number of the types of mishaps presented in table 4 also occurred near airports. Mishaps near locations other than heliports and airports fell into a narrow range of mishap types. This is likely true because many of the types of obstructions located near heliports or airports typically are not found near sites contained in the "other" category, such as hangers, drainage grates, perimeter lights, etc.

For ease of understanding potential landing site problems, the large number of mishap types identified in table 4 were condensed into an abbreviated set of mishap types. The list of abbreviated mishap types, which includes all landing sites, is presented in figure 9 along with the percentage of occurrence of each type. Figures 10, 11, and 12 break out the percentages of types of mishaps near heliports, airports, and "other" facilities, respectively.

As shown in figure 9, obstruction strikes represented the bulk of mishaps. In fact, 60 percent of the mishaps were obstruction strikes, 38 percent occurring on the landing site and 22 percent near (within 1 mile) the landing site.

Table 5 presents the number of mishaps by landing site and type of operation. The majority of civil mishaps occurred while operating under Part 91. However 20 percent of the civil mishaps chosen for the study did occur while operating under Part 135. It is interesting to note that none of the Part 135 mishaps occurred at an airport. Table 5 is presented to show only a breakdown of those mishaps used in the study and is not meant to represent relative safety based upon type of operation.

TABLE 5
MISHAP BY TYPE OF OPERATION

	Heliport		Airport	Other
	Public	Private		
Part 91	3	22	16	8
Part 135	1	9	0	4
Military	0	10	25	19

The following is a review of the types of mishaps which occurred near various facilities and a brief description of each.

5.1.2.1 Obstruction Strikes (on-facility)

There were numerous obstruction strike mishaps found in the mishap database. When analyzing the various obstructions that were struck, it appears that almost every object near the operational area is a potential threat to the helicopter. Many of these obstruction strikes occurred at landing sites that do not meet the advisory circular guidelines.

TABLE 4
MISHAP TYPE

DESCRIPTION	HELIPORT	AIRPORT	OTHER
Hit Trees on Approach	1	1	
Rotorwash Damage on Approach	1	1	1
Rotorwash Affected Departing A/C		1	
Rotorwash Damage to Parked A/C	1	3	2
Rotorwash Damage on Departure	1		2
Tire Struck Taxiway Light		1	
WSPS Struck Taxiway At Surface Dip		1	
Power Loss on Takeoff	4	5	4
Inadequate Wind Indication	3	1	1
A/C Struck Fuel Vent Pipe		2	
Refueling Fire		1	
Hit Wires on Takeoff	6		11
Tail Wheel Struck Perimeter Light	1		
Wind Sock Separated and Struck A/C	1		
Refueling Location Forced Operation in Tailwind	1	1	
Hit Trees on Departure			3
Struck Wires in FATO Area			1
Hit Wires on Approach			5
Engine Fire	1		
Insufficient Climb Angle on Takeoff	3		
Power Loss on Approach	2		
A/C Struck Safety Railing	1		
Skid Struck Dolly	1		
Skid Struck Perimeter Light	1		
Skid Hit Object in Grass		1	
Skid Struck Grounding Eye		1	
Skid Stuck in Drainage Grate		1	
Skid Caught on Lip of Pad	1	1	
Skid Stuck in Asphalt		1	
Skid Stuck in Sand		1	
Skid Struck Protruding Bolts	1		
M/R Struck Hangar	1	2	
M/R Struck Trees Along Taxiway		1	
M/R Struck Telephone Pole		2	
M/R Struck Utility Pole	1	2	
M/R Struck Parked Aircraft	1	5	
M/R Struck Sign Pole		2	
M/R Struck Light Pole	1	2	1
M/R Struck Wind Sock	1		
M/R Struck Porch	1		
T/R Struck Fuel Pump	1		
T/R Struck Perimeter Light	2		
T/R Struck Passenger	4		
T/R Struck Fence	1		
Other	1		
Total	45	41	31

A/C = Aircraft
WSPS = Wire Strike Protection System
FATO = Final Approach and Takeoff Area
M/R = Main Rotor
T/R = Tail Rotor

Note: Horizontal lines in table are included as an aid in aligning rows.

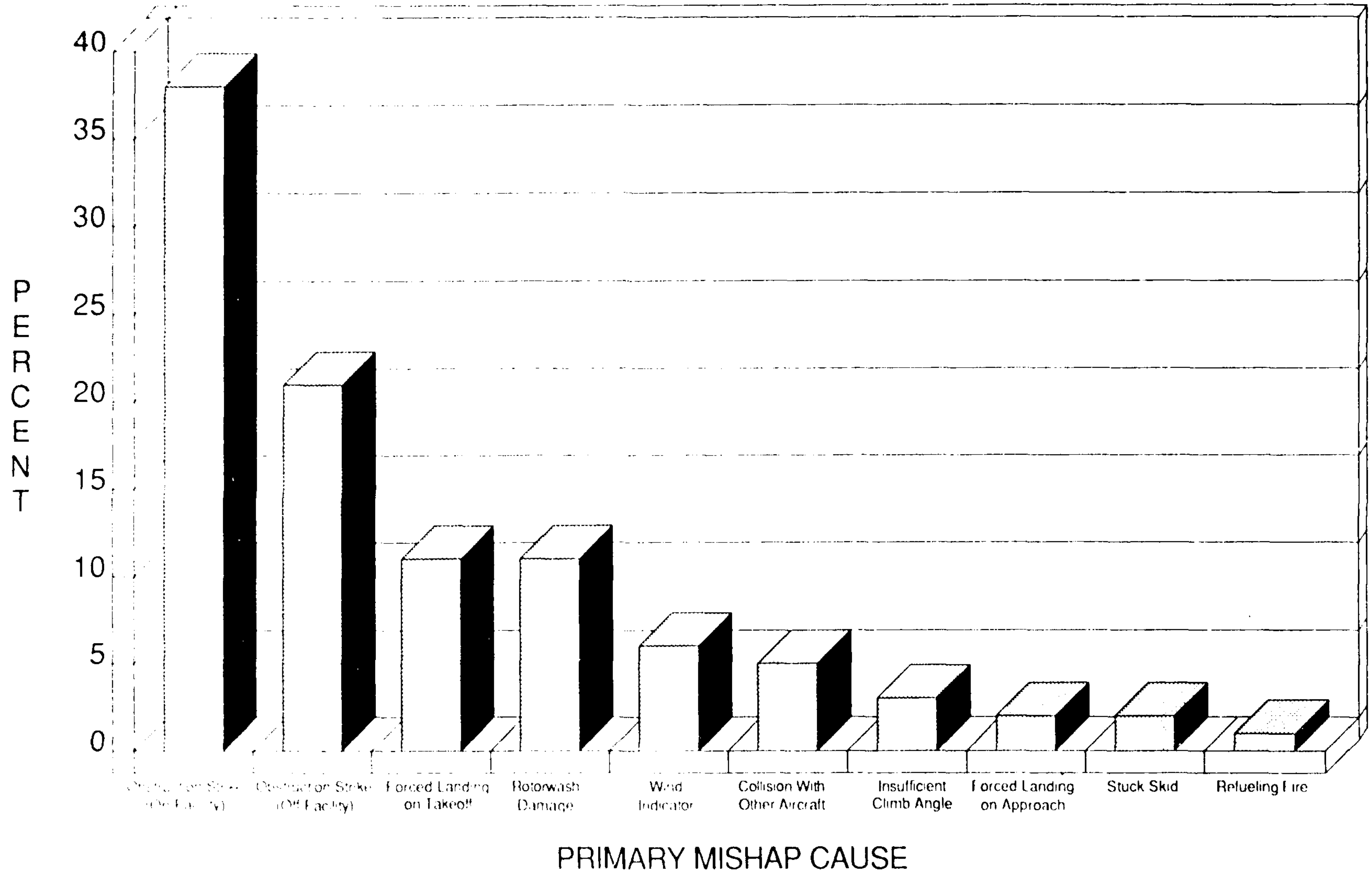


FIGURE 9 GENERAL MISHAP TYPES

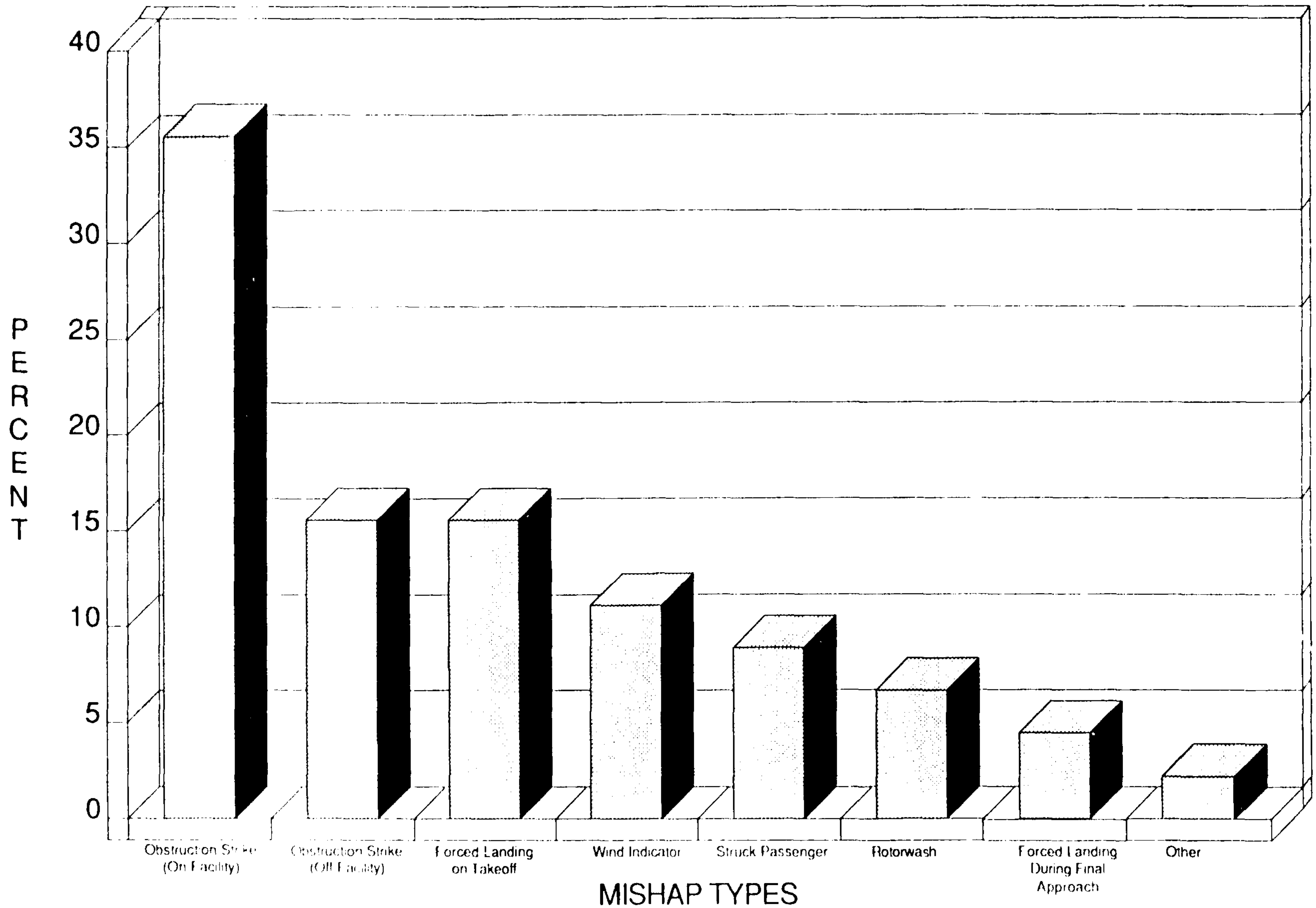


FIGURE 10 MISHAP TYPES AT/NEAR HELIPORTS

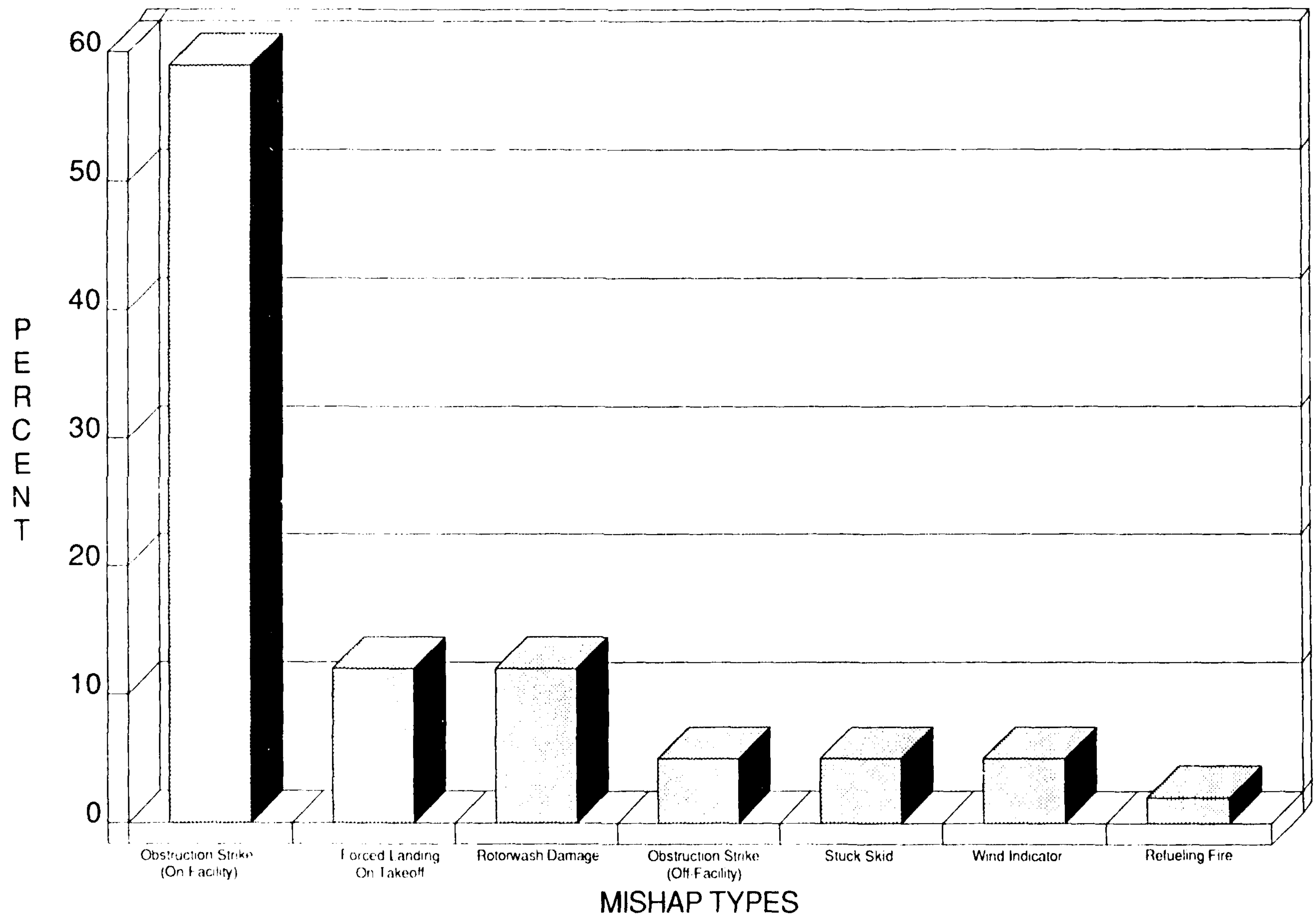


FIGURE 11 MISHAP TYPES AT/NEAR AIRPORTS

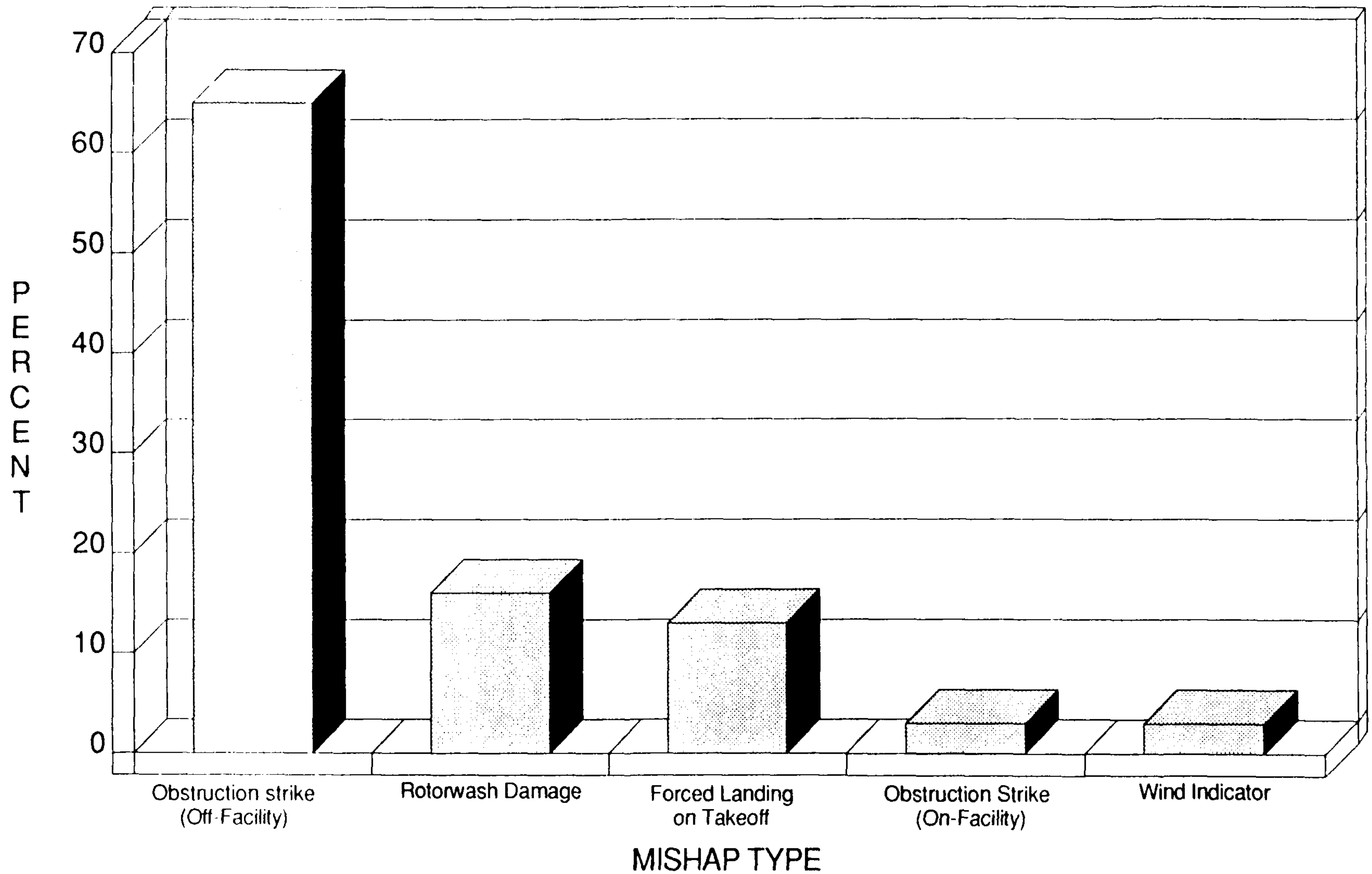


FIGURE 12 MISHAP TYPES AT/NEAR OTHER LOCATIONS

However, there are lessons to be learned by looking at these mishaps. The items that were struck at landing sites include the following:

taxiway light	telephone pole
perimeter light	sign pole
wind sock	utility pole
hangar	light pole
vent pipe (fuel pump)	taxiway (dip in taxiway)
trees (near taxiway)	helipad lip (raised helipad)
grounding eye	guy wire
safety railing (rooftop)	drainage grate
fuel pump	parking dolly
personnel	protruding bolt (rooftop)
safety fence	

From the above list, several observations can be made. The need for relatively flat/clean operating surfaces is confirmed by the mishap database which shows that helicopter skids caught on a variety of objects, such as a protruding bolt, the helipad lip, grounding eye, and a drainage grate. A dip in the taxiway caused a wire strike protection system (WSPS) to strike the ground during a wheeled taxi. In addition, loose dirt and snow were responsible for brownout and whiteout conditions which resulted in obstruction strike mishaps.

Large objects which were struck such as hangars, light poles, sign poles, etc. highlight the difficulty in judging clearances from objects. Several of the mishaps occurred despite using a ground marshal to assist in the movement of the aircraft. These mishaps are a clear indication that judging obstruction clearances may be a difficult task. The large number of obstruction mishaps also implies that operational areas are too small at some heliports.

Another interesting observation is that objects designed specifically for safety purposes are not themselves immune from mishaps. Objects such as safety fences, railings, grounding eyes, and wind socks were involved in several helicopter mishaps. Finally, personnel strikes refer to passengers walking into turning tail rotors. Unfortunately, some of these accidents occurred even when passengers had been thoroughly briefed on safety procedures.

5.1.2.2 Obstruction Strikes (off-facility)

Obstruction strikes that occur near landing sites indicate the need for adequate clear space in which to operate helicopters. The kinds of obstructions that were struck near landing sites include the following:

telephone wires,
guy wires,
power lines,
noise berms, and
trees.

While there were a number of obstruction strikes near landing sites, the number of different types of objects that were struck was limited when compared to on-facility strikes. The mishaps occurring near landing

sites occurred during both approach and departure. As noted earlier, the off-facility mishaps were important from a protected airspace design aspect. Unfortunately, the majority of these mishap reports did not contain detailed information as to where the obstructions were with respect to the landing site. However, in cases of wire strikes, the pilot did not see the wire in sufficient time to prevent the wire strike.

5.1.2.3 Forced Landings on Takeoff

This group of mishaps involved the need to immediately land the aircraft during the takeoff or initial climbout. They occurred for several reasons including, mechanical or material failure, other emergencies, and insufficient power for the operating conditions. These mishaps highlight the benefits of providing as much operating space as possible and/or practical.

5.1.2.4 Rotorwash Damage

Rotorwash damage occurred primarily during approach and departure. These mishaps usually involved damage to parked vehicles under or near the operating area. In one extreme case, rotorwash caused a woman to fall and break her leg. In another instance, the rotorwash from a hovering helicopter, holding at an intersection, destroyed the ground effect of a helicopter attempting to take off. Rotorwash also caused damage to parked aircraft. All of the rotorwash mishaps used in this study were associated with military operations. However, they occurred at both civil and military facilities.

5.1.2.5 Wind Indication

Several mishaps occurred due to the influence of the wind on rotorcraft operations. Most of these mishaps involved operations in unexpected wind conditions. It appears in these mishaps that the pilot may have been unaware, or, may have been misled about the actual wind conditions during the operation. One instance involved operating next to a row of hangars. The hangars obstructed the wind nearby. Upon departing the area the helicopter encountered a strong tailwind and downdraft resulting in the helicopter crash. Another instance involved a helicopter operating next to a hospital. As the helicopter flew around the building it encountered wind conditions which, according to the pilot, caused the vertical speed indicator to register an increase in descent rate of nearly 3,000 feet per minute. In both instances the altering of the prevailing wind by the buildings appears to have contributed to the mishaps. In these instances, wind information available to the pilot at the facility did not adequately represent the actual operating conditions. Reference 6 addresses the subject of wind flow near structures.

In addition to availability, placement of the wind sock is also critical, not only to provide an accurate wind indication, but also for safety of operations. One helicopter struck a wind sock while operating on the heliport, while in another case the wind sock was separated from its mounting by rotorwash and struck the main rotor.

5.1.2.6 Collision with Other Aircraft

There were several instances of on ground collisions between aircraft. These collisions occurred in parking areas and usually involved a parked aircraft being struck by an aircraft trying to maneuver

in the parking area. Here again, as in the case of obstruction strikes, judging clearances from turning rotor blades proved difficult. Two separate mishaps occurred when both aircraft were parked. While one aircraft was standing with rotors turning, an adjacent aircraft began turning rotors with inadequate spacing between rotor systems.

5.1.2.7 Insufficient Climb Angle

These mishaps occurred on departure immediately after takeoff. Insufficient climb angle mishaps occur for several reasons, such as failing to compensate for high density altitudes or encountering an unexpected tailwind while operating at maximum performance limits. In all cases, the aircraft was unable to sustain flight and impacted the ground. These mishaps indicate the need to provide clear groundspace and the need for the pilot to fully understand the operating environment and operating limitations of the aircraft.

5.1.2.8 Forced Landing During Final Approach

These mishaps involved a loss of power or any other reason requiring subsequent forced landing during final approach. As in the case of forced landing on takeoff, they indicate the benefit of providing clear groundspace underlying the approach corridor

5.1.2.9 Stuck Landing Gear

These mishaps occurred because the operating surface was inadequate to support the weight of the aircraft. Examples include a helicopter which attempted to lift off with a skid stuck in asphalt and another with a skid stuck in soft sand. Both aircraft rolled over as they attempted to lift off. The mishap involving the aircraft with the skid stuck in asphalt highlights the importance of designing a surface capable of supporting the aircraft under all operating conditions. For instance, concrete may be preferrable to asphalt, particularly in areas which may experience extremely warm temperatures. In these locations skids may make indentations in asphalt surfaces which can present a hazard to operations. Helicopters with wheeled landing gear are also prone to this type of problem.

5.1.2.10 Refueling Fire

Although there was only one refueling fire mishap used in the study, it did point to the need for constant vigilance during refueling operations. In this particular mishap the helicopter was being refueled after having been shut down. However, the cooling fan was left running. During the refueling the helicopter was left unattended. The automatic shutoff on the refueling nozzle failed, and a fuel spill occurred. The fuel subsequently ignited and the helicopter was destroyed.

5.2 DESIGN ISSUES

This section addresses the design issues which may have contributed to the mishaps considered in this study. The intent is to gain an understanding of the manner in which current heliport design standards may contribute to mishaps, to identify any needed changes, and to formulate recommendations in order to provide a safer operating environment for helicopters.

The design issues identified in this study and the percentage of mishaps related to each are shown in figure 13. There were several design issues which were pertinent to the majority of the mishaps. Following is a discussion of each design issue and examples of how it applies to the mishap database.

5.2.1 Approach/Departure Obstruction Marking/Clearance (21.4 percent of mishaps)

Wire strikes in both the approach and departure phases of flight represent the majority of mishaps for this group. Unfortunately, due to the lack of detail in the majority of these mishap reports, it was impossible to determine the exact location of the wires with respect to the landing site. In the two reports that did contain information as to the location of the wires, the wires were located within the 8:1 protected airspace surface. This indicates that the approach/departure airspace did not meet the advisory circular criteria for public heliports.

In all of these wire strike mishaps the wires were not marked with obstruction markers and the pilots failed to see the wires in time to avoid them. This subset of mishaps highlights the need for facility operators to insure that obstructions, especially wires, which lie in the approach/departure corridors are marked and identified. In most instances State and Local authorities will assist operators in marking obstructions.

In addition to wire strikes, there were several obstruction strikes involving trees. These strikes occurred on departure. Here too, the mishap reports lacked specific details as to the location of the trees with respect to the final approach and takeoff area (FATO). However, from the report descriptions it can be said that the pilot did know the trees were present prior to beginning the takeoff procedure. These mishaps point out the need for adequate clearance on departure. This design issue is coupled with a related operational/human factors issue of the pilot knowing and observing the performance capabilities/limits of the aircraft under the prevailing environmental conditions.

5.2.2 Approach/Departure Groundspace (18.8 percent of mishaps)

The majority of mishaps in this category represent power loss on takeoff. They were all civilian mishaps and involved a reported mechanical malfunction on takeoff. Here again, due to the lack of details in the official reports, it was not possible to infer the amount of groundspace that may be desirable. However, considering the number of mishaps involving a power loss on takeoff, providing as much groundspace as possible appears appropriate.

Another type of mishap included in this category were those involving rotorwash damage to vehicles/items on the ground from arriving and departing aircraft. It appears that the arrival and departure corridors did not have sufficiently clear or compatible groundspace to prevent these mishaps.

5.2.3 Parking Area Design (17.9 percent of mishaps)

These mishaps primarily involved obstruction strikes in the parking area. A variety of objects including telephone/light/utility poles, parked aircraft, hangars, perimeter lights, and a drainage grate, were

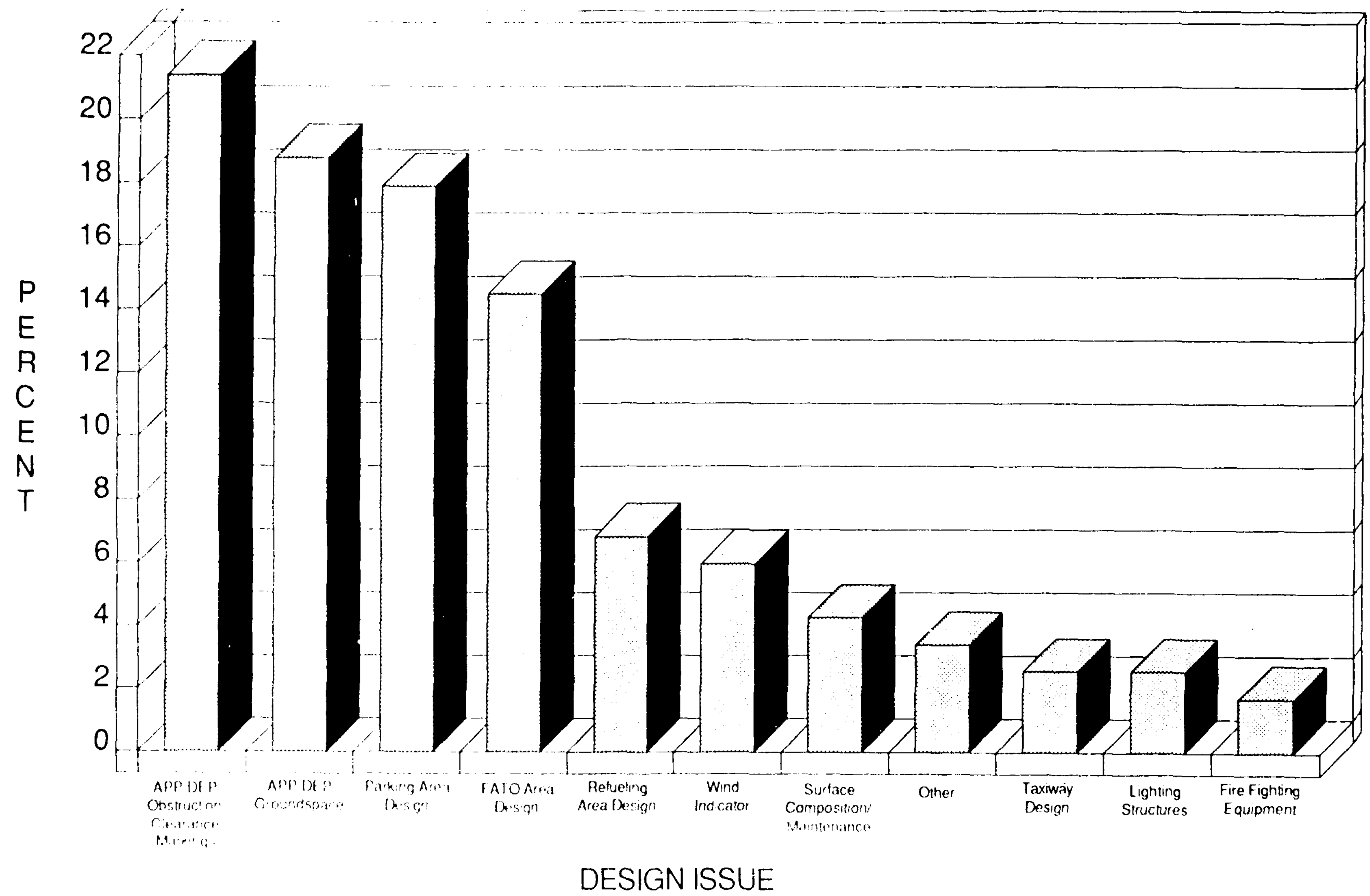


FIGURE 13 GENERAL DESIGN ISSUES

struck in the parking area. In several instances, these mishaps occurred while the pilot was being guided by ground personnel. This highlights the difficulty in judging clearances between rotating blades and obstructions. Several mishaps involved rotorwash damage from operating too close to parked aircraft. All of these mishaps involved errors in judging distance and may indicate a need for better ground markings to help the pilot judge where the aircraft may or may not be operated safely. If adequate guidance is available to the pilot, many of these types of mishaps may be avoided.

Two mishaps involved helicopters which were started while adjacent helicopters were standing with rotors turning. When the second aircraft was started, the blades intermeshed. These mishaps again were caused by errors in judgment. However, had there been adequate ground markings outlining the parking area, including the space required to safely turn rotors, these mishaps may have been avoided.

5.2.4 <u>FATO Design (14.5 percent of mishaps)</u>

FATO mishaps generally involve striking objects such as wires, poles, fences, etc., while operating in confined takeoff and landing areas. Because of their unique maneuvering and lifting capabilities, there is a tendency to operate helicopters in very confined areas. These situations may lead to mishaps due to the excessively high demands placed on the pilot and the difficulty in judging main rotor and tail rotor clearances from obstructions. Another mishap placed in this category involved a helicopter whose ground effect was destroyed on takeoff by another hovering aircraft which was waiting to take off. In this case the second aircraft was hovering too close to the takeoff/landing area.

Other FATO related design mishaps included hitting the lip of a raised landing surface and landing on a pad that was too small for the size of the aircraft. The first involved an aircraft which was manuevering to land on a raised helipad. The helipad was elevated approximately 1 foot above the ground. The helicopter skid caught on the side of the raised helipad while manuevering. The latter mishap occurred when the pilot tried to land the helicopter on a helipad that was designed for smaller aircraft. When the collective was fully lowered after landing the helicopter rolled forward approximately 2 inches and struck a perimeter light.

5.2.5 <u>Refueling Area Design (6.8 percent of mishaps)</u>

Refueling area mishaps mainly involved obstruction strikes. Objects which were struck included sign poles, light poles, fuel pumps, vent pipes, and grounding eyes. Several of these mishaps were caused by the fact that the design and/or operation of the refueling area forced the helicopters to operate in a crosswind/tailwind situation to facilitate refueling. Consideration of adverse wind needs to be incorporated into the design of refueling areas. It appears that a significant factor in many of these mishaps is that the refueling areas and procedures were designed primarily to accommodate fixed-wing aircraft and did not take into account any special considerations that might be required for rotorcraft refueling.

5.2.6 Wind Indicator (6.0 percent of mishaps)

The most prominent type of mishap in this category involved a lack of proper wind indication, which resulted from operating in an area where the wind was obstructed or masked by nearby buildings or trees. When the aircraft was clear of the obstruction, it encountered a prevailing wind that was much different than the wind condition near the obstruction. In a typical mishap scenario the pilot would find himself/herself operating in a tail wind once the aircraft was clear of the object. The location of the wind indicator did not accurately represent the operating conditions the helicopter would encounter. Placement of the wind sock is important for indicating operating wind conditions, but at the same time the wind sock must not become an obstruction.

5.2.7 Surface Composition/Maintenance (4.3 percent of mishaps)

Surface composition and/or maintenance were factors in several mishaps. Instances of brownout or whiteout are caused by either improper care and maintenance of landing facilities, or, poorly selected surface composition. Maintenance is a very important aspect of heliport operations. In several instances rotorwash was responsible for blowing rocks and other debris causing damage to buildings and vehicles. In addition to causing property damage or injury to personnel, debris picked up by rotorwash may cause damage to the helicopter itself. An object as seemingly harmless as a small plastic bag can be catostrophic to a turning tail rotor.

In two instances, stuck skids were responsible for aircraft rolling over. These mishaps certainly highlight the need for landing surfaces adequate to support the weight of the aircraft under all weather conditions. Intense heat and direct sunlight may soften asphalt enough to allow skid or wheeled aircraft to become embedded. Concrete may be preferable at these locations.

5.2.8 Taxiway Design (2.6 percent of mishaps)

The taxiway mishaps analyzed in the study occured at airports. Airports are designed primarily for fixed-wing aircraft operations and do not always consider the needs of rotorcraft. One mishap involved a wire strike protection system on a wheeled aircraft striking the pavement at a dip in the taxiway. While the dip did not represent a problem to fixed-wing aircraft, it did represent a hazard to rotorcraft. Another incident involved main rotor blades striking a tree while the helicopter was taxiing on a designated taxiway. This incident may have been due, at least in part, to pilot inattention. However, providing adequate obstruction clearance is essential, especially for rotorcraft, where judging rotor obstruction clearance can be difficult.

5.2.9 Lighting Structures (2.6 percent of mishaps)

Heliport perimeter lights were struck in several instances by both tail rotors and skids. These mishaps certainly support the use of flush mounted lighting where possible and low impact resistance lights in areas where snow may preclude the use of flush mounted lights.

5.2.10 Fire Fighting Equipment (1.7 percent of mishaps)

There were two mishaps involving helicopter fires and the use of fire fighting equipment. The first mishap occurred during a refueling operation while the aircraft's engine was shut down and a cooling fan was left running. A fuel spill occurred during refueling and was ignited. The ensuing fire totally destroyed the helicopter. This mishap, although only one in number, highlights the need for extreme caution during refueling operations. Because of the volatility of fuel, extreme care is essential during refueling. The second mishap involved a fire which occurred following catastrophic engine failure. The immediate availability of fire fighting equipment helped to minimize the extent of damage to the helicopter in this mishap.

5.3 OPERATIONAL ISSUES

The intent of this study was to focus on heliport design issues. However, in analyzing mishap reports, several operational issues were noted. These issues are presented below for discussion purposes but they will not be the subject of recommendations from this report.

5.3.1 Passenger Loading/Unloading

Passengers being struck by tail rotors during loading and unloading continues to be a problem. Specific guidelines are provided in the Heliport Design AC for loading and unloading passengers. However, despite the attention given to this subject in the advisory circular, the problem continues. In fact, there were 13 persons struck by tail rotors between 1983 and 1986. The seriousness of the consequences of this type of mishap suggests that a great deal more needs to be done in this area. However, additional guidance should be developed from an operational viewpoint and not in the form of additional design standards.

Helicopter manufacturers have made efforts to reduce the number of mishaps involving tail rotor strikes to personnel. Through research and development efforts one manufacturer has developed a paint scheme that appears to make their rotating tail rotor more visible. The number of tail rotor strikes involving these aircraft have been reduced by half since introduction of the new paint scheme. While the new paint scheme may not account for the entire reduction in personnel tail rotor strikes, it does appear to have had a definite positive effect.

5.3.2 Ground Marshal Availability/Training

Several of the obstruction strikes occurred in parking areas while being assisted by ground personnel. The types of obstructions that were struck included poles and hangars. It is obvious from these mishaps that the assistance of ground personnel in manuevering aircraft does not preclude mishaps from occurring. Currently, there are no FAA guidelines addressing the need for or proper use of ground marshals. However, proper training of helicopter ground marshals may help prevent the majority of obstruction strike mishaps which occur while using ground marshals.

Training material could cover a variety of aspects of ground manuevering operations, such as the proper place to stand in order to observe obstruction clearances and provide direction to the pilot, the difficulty in judging rotor clearances under various conditions, and the turning radii of various aircraft including tandem rotor aircraft. The training, while not necessarily extensive, would instill in the ground marshal a better appreciation for some of the difficulties and hazards of confined area manuevering as well as techniques and knowledge for clearance assistance.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented herein are based on the review and in-depth analysis of mishaps which occurred on or near landing facilities of various types. The conclusions identify heliport design related factors which may contribute to the types of mishaps analyzed in the study. The numbered recommendations summarize areas in which changes to FAA Advisory Circular 150/5390-2, "Heliport Design," are appropriate.

These conclusions and recommendations are offered for consideration in the design of all heliports whether they be public-use or private, and whether the helicopter takeoff and landing area is specifically intended as a heliport, is located on an airport, or is used only occasionally for helicopter operations. It is also recognized that not all conclusions and recommendations apply to all heliport situations, and that the design parameters to be considered at a specific location will depend upon a number of factors, including the number of actual or anticipated operations, type of operations, whether the facility is for public or private use, services provided, environmental factors, etc.

It is important to state here what may appear to be the obvious. That is, that good operational procedures would help to alleviate a number of landing site mishaps. Whether mishaps occur at heliports, airports, or unimproved sites, safe operating procedures play an extremely important role and are just as critical as the landing site design.

6.1 ADVISORY CIRCULAR OVERVIEW

In general, the FAA Heliport Design Advisory Circular provides very good guidance for the design of safe heliports. Many of the mishaps analyzed in this study would likely not have occurred if the advisory circular design parameters had been satisfied at the mishap facility. (About 70 percent of the mishaps used for the indepth analysis occurred at landing sites that did not meet the design standards provided in the Heliport Design AC.) The study therefore concludes that the advisory circular is basically a sound and valid instrument.

The mishap data suggests that additional emphasis should be added in some areas of the Heliport Design AC to highlight specific aspects of heliport design which may be significant to mishap prevention. The numbered recommendations contained in the following paragraphs relate to the subjects where expansion is recommended.

One finding of this study is that obstruction strikes are the leading cause of helicopter mishaps at airports. The percentage of mishaps involving obstruction strikes is nearly five times the percentage of the next largest cause factor. Therefore, based upon this finding, the following general statement is presented. Chapter 4 of the advisory circular, "Helicopter Facilities at Airports," should be significantly expanded to include discussions of obstruction marking and obstruction clearance.

6.2 FACILITY DESIGN ISSUES

Facility design issues were identified in 117 (2.6 percent) of the 4,428 mishaps reviewed in the study. Undoubtedly, facility design issues were a factor in a number of other mishaps, but the mishap summaries acquired from the NTSB and the U.S. Army were not sufficiently detailed to identify the specific mishaps of interest.

It was hoped that the mishap reports would indicate the adequacy of current advisory circular airspace and groundspace guidelines. However, the lack of detail in the reports did not allow for such a determination. In fact, the level of detail in the mishap reports indicates that in many cases there is insufficient data to draw conclusions concerning specific issues. The analysis of mishaps is extremely valuable and may indicate where improvement is needed. However, for issues where precise guidelines are required, the mishap reports did not provide adequate data; therefore, research and development efforts are needed to provide specific guidance. This study has shown that this is certainly true for the case of determining the required amount of protected airspace needed at landing sites. The mishap reports lack the detail needed to make this determination.

Operational issues were also identified in some of the 117 design-related mishaps. This finding reinforces the fact that both good design practices and good operating practices are necessary to avoid mishaps at facilities.

6.2.1 Mishap Locations

The 117 selected helicopter mishaps used in the study occurred at heliports, airports, and other operational areas in approximately equal numbers (coincidentally, not as a result of any selection parameter).

Location	Number	Percent
Heliport (Public)	4	3
Heliport (Private)	41	35
Airport	41	35
Other Operational Areas	31	27
Total	117	100

Mishaps occurred in all locations on and around the helicopter takeoff/landing site. The greatest percentage of mishaps occurred in parking areas (28 percent), followed by departure airspace (19 percent), departure groundspace (15 percent), the FATO (14 percent), and approach airspace (10 percent).

6.2.2 Heliport Design Issues

At heliports, the largest percentage of mishaps were obstruction strikes on the heliport (36 percent), followed by obstruction strikes off the heliport (16 percent), power loss on takeoff (16 percent), and mishaps related to wind indicators (11 percent).

Based on these findings the following recommendations are offered regarding heliport design:

1. <u>Enhance landing site obstruction avoidance capabilities.</u> - Rotor strikes continue to occur including strikes to poles, hangars, and other obstructions. Suggestions on how to reduce these mishaps seem appropriate. For example, placing boundary lines near hangars, poles, and other obstructions may aid the pilot in judging distances from those obstructions. Because different size helicopters will operate at a facility, boundary lines highlighted with script, such as "DO NOT CROSS", may be preferable to centerlines. An additional suggestion is to place strips of fluorescent paint/tape on the obstruction itself. This will aid the pilot in judging distances from the obstruction and also highlight the obstruction, especially poles, on overcast days and at night.

   On-ground multiple aircraft collisions also continue to occur. Those considered in the study occurred in parking areas. Providing specific ground markings, such as those presented in "Heliport Surface Manuevering Test Results" (reference 2), may help alleviate this problem. For example, providing a circle and defining the maximum allowable rotors turning diameter, such as 44D for a 44 foot maximum rotor diameter (circle diameter 74 feet, 44 feet + 15 feet clearance on each side), may prove helpful to the pilot. Other suggestions are also presented in reference 2. (Reference 2 also indicates a need to reexamine the adequacy of the one-third rotor diameter tip clearance at public heliports.)

2. <u>Lower the obstruction marking height requirements.</u> - Obstruction strikes, especially wire strikes, continue to be a significant problem. Establishing a visual margin of safety below the current 8:1 approach/departure surface is recommended. It is recognized that the most critical problem exists close to the facility. Therefore, a more stringent recommendation is made for the first 500 feet out from the heliport. Thereafter, a slope which results in a 100 foot buffer below the 8:1 approach/departure surface at 4,000 feet is recommended. The recommendation is to mark all obstructions, especially wires, that lie under the 8:1 approach/departure surface, are not shadowed by another object, and are:

   a) above a 25:1 slope within 500 feet of the FATO; and

   b) are above a 9.21:1 slope thereafter (see figure 14).

   The 9.21:1 slope ensures that the 100 foot buffer at 4,000 feet from the heliport is satisfied.

3. <u>Provide sufficient clear space near the landing site to support improved operational and safety needs.</u> - This recommendation is sensitive to the difficulty and expense of acquiring or controlling land use near a landing site. However, providing

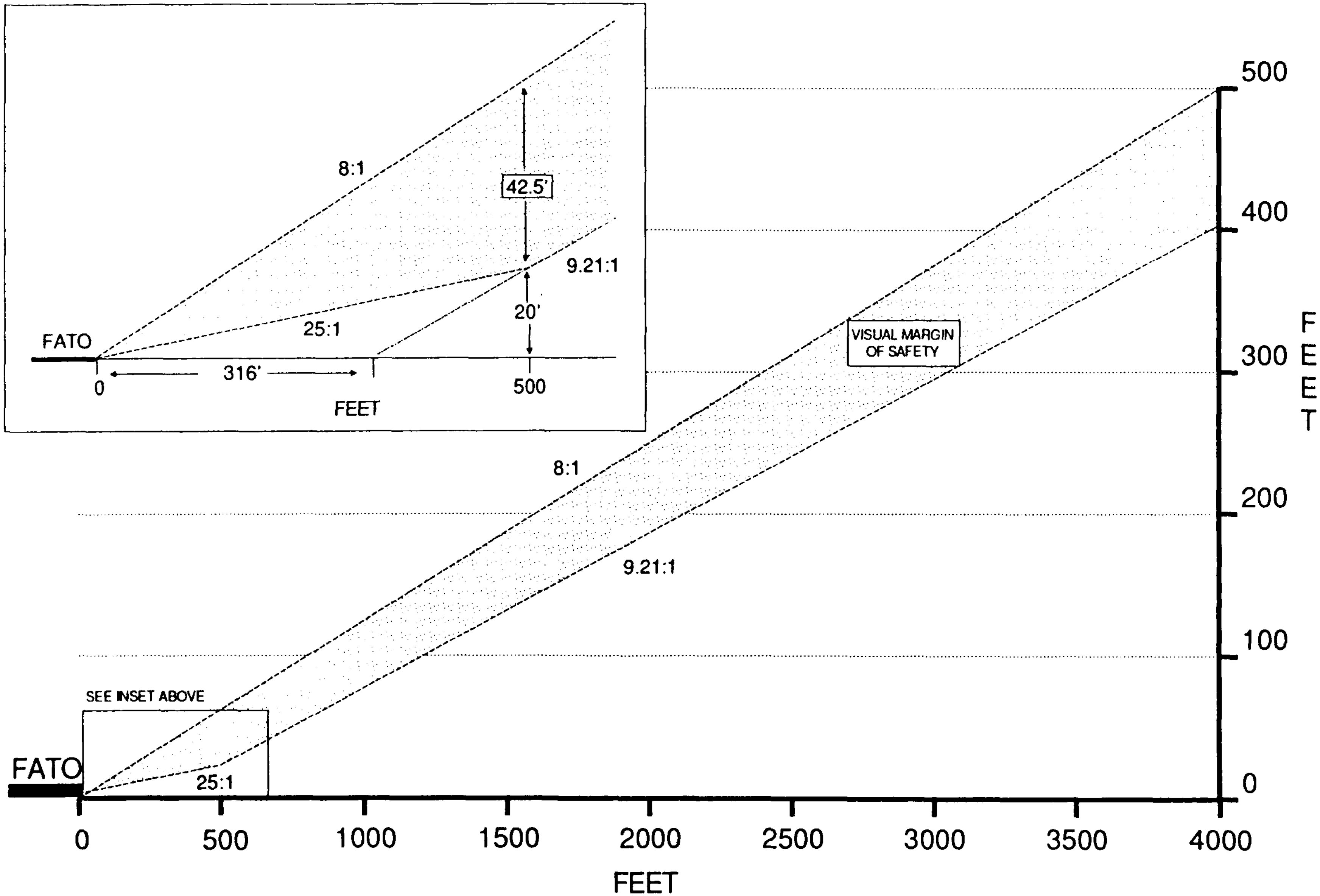


FIGURE 14 PROPOSED OBSTRUCTION MARKING ZONE

additional land under the approach/departure corridor(s) has several benefits. This land:

- o provides additional ground/air space to support acceleration through translational lift, thereby increasing the payload and operational capability of the helicopter,
- o increases the capability of the helicopter to operate productively at higher density altitudes,
- o provides a safe landing area in the unlikely event of a malfunction requiring a forced landing immediately after takeoff, and
- o provides a safe landing area in the unlikely event of a malfunction requiring an immediate landing during approach.

4. Install additional wind indicators where needed. - This recommendation is directed at those locations where operations occur near large buildings or obstructions. Typical locations include heliports adjacent to hospitals, heliports with hangar facilities, and city-center heliports where the wind may be obstructed or channeled by surrounding buildings and thereby alter its velocity and/or direction. Multiple wind socks should be considered when obstructions may affect the accuracy, applicability, or visibility of a single wind sock.

5. Provide proper heliport surface composition and adequate surface maintenance. - Helicopters are sensitive to the composition and condition of the operating surface. Any protruding obstruction, no matter how small, may cause a mishap. It is also essential that the operating surfaces be able to support the helicopter under all conditions. Landing gear may stick in sand, dirt, mud or even asphalt on hot days. Concrete is preferable to asphalt. It is also essential that operating areas remain free of debris to prevent rotorwash blown objects from potentially injuring personnel, damaging property, or causing damage to the helicopter.

6. Remove the "hold open rack" feature on refueling nozzles. The "hold open rack" allows the operator to refuel aircraft without having to manually hold the fuel nozzle open. This feature allows the operator to walk away from the aircraft during the refueling operations. The automatic shutoff feature in the refueling nozzle is a safety feature and should not be relied upon to stop the refueling. The consequences of a fuel spill are too great and therefore any device that allows automatic refueling should be removed.

6.2.3 Airport Design Issues

At airports, the largest percentage of helicopter mishaps were obstruction strikes on the airport (59 percent). Other significant cause factors included mishaps related to forced landing on takeoff (12 percent), and rotorwash (12 percent).

Based on these findings, the following recommendations are offered regarding heliport design at airports:

1. Obstruction Avoidance - There are primarily two types of helicopter obstruction strikes occurring on airports -- rotor (main and tail) strikes and landing gear strikes. There are a considerable number of objects at most airports that represent potential obstructions to helicopters. Several options concerning parking and refueling areas are presented to reduce these hazards:

   - Use trucks to refuel helicopters to avoid having to position the helicopter too near the refueling facilities.

   - Install long refueling hoses in the refueling areas to avoid having to position the helicopter too near the refueling facilities.

   - Recess facility operational equipment, such as grounding rods, tie-downs, etc. Flush mount lights when not prohibited by operational factors such as snowfall. Use low impact resistance mountings for lights when flush mounting is impractical.

   Another important consideration in helicopter obstruction avoidance at airports is the use and placement of ground markings. Usually designed for fixed-wing aircraft, markings provide both guidance and obstruction clearance. However, these same markings, particularly centerlines, may not provide adequate clearance for rotary-wing aircraft, and, in fact may be misleading to the helicopter pilot, resulting in a mishap. Three suggestions to help prevent obstruction strikes are presented here:

   - Place specific (distinguishable) taxi lines in refueling areas for use by helicopters. They must be placed far enough from the fuel pumps and surrounding obstructions to accommodate the largest expected helicopter. These lines must be noted, possibly with script, as specifically for use by helicopters, such as "HELICOPTER USE". The fixed-wing centerlines may be scripted with "NO HELICOPTERS NO."

   - Place specific boundary lines near obstructions to help the rotary-wing pilot judge distances to objects. These lines might be highlighted with script such as "CAUTION HELICOPTER - DO NOT CROSS".

   - Mark obstructions, especially poles, with strips of fluorescent paint or tape to highlight them. This is especially helpful at night or on overcast days.

2. <u>Operating surfaces must be flat, free of debris, and well maintained.</u> - Loose objects and debris in and around helicopter operating areas on airports have been responsible for a number of mishaps. Because of rotorwash, helicopters and helicopter operations are extremely sensitive to debris. Objects such as tarps, plastic bags, rocks, dirt, and snow represent operational and safety hazards to helicopters. Dirt and snow are responsible for brownouts and whiteouts, respectively. Rocks and other debris blown around by rotorwash have caused physical damage to nearby structures, aircraft, and personnel, while tarps and plastic bags picked up by rotorwash have damaged main and tail rotors. Depending upon the nature of the mishap, damage can lead to a catostrophic mishap involving total loss of the aircraft.

   Besides being free of debris, operating surfaces must be flat. Objects placed in helicopter operating areas should be recessed whenever possible. Helicopters at airports have caught skids on grounding eyes and tie-downs.

Helicopters have considerable flexibility and may operate from many locations on an airport. However, most airports have one or more designated takeoff/landing area(s), usually located on a parallel taxiway adjacent to an operable runway. At times air traffic controllers accommodate operations to/from areas other than the designated takeoff and landing areas. This accommodation is made for a variety of reasons, to include time savings, separation from fixed-wing aircraft, increased operations, and ease of pilot/controller workload. Design consideration should therefore be given to operating areas other than the designated takeoff and landing area on the airport or runway. For instance, if take offs and landings routinely occur near fixed-base operator's facilities (FBO), then FATO design standards should be applied to that location.

The following specific items are included for those airports where operations do occur at other than the designated helipad location or runway. These items are included as guidance to assure that helicopter operations will be afforded an adequate margin of safety at all times.

3. <u>Mark wires in the approach/departure corridor.</u> - If helicopters take off or land at other than a designated helipad location or runway (e.g. near airport boundaries), marking wires under the approach/departure corridor may be appropriate. The suggested guidelines for marking wires are the same as discussed for those near heliports in section 6.2.2.

4. <u>Install additional wind indicators.</u> - When helicopters routinely take off or land at other than a designated area or runway, additional wind indicators may be warranted. This is especially true when these operations occur near buildings, hangars, or other large obstructions.

5. <u>Remove the "hold open rack" feature on refueling nozzles.</u> Removal of this feature will help to ensure that the aircraft will be attended during refueling (see section 6.2.2).

6.3 CIVILIAN MISHAP DATA

In performing the analysis for this study, several items specific to the civil mishap database and information availability were noted. Recommendations to enhance the data, from a rotorcraft mishap analysis perspective, are presented below.

6.3.1 Update NTSB Mishap Form

The NTSB investigator's report form has undergone several changes over the years. The current form includes supplements which contain pertinent mishap information. However, these supplements are not always used by the investigators. Therefore, it is suggested that the term "heliport" be included in the accident location field on the primary factual report form. In addition, this field should also incorporate the term "vertiport" in anticipation of certification and integration of tiltrotor aircraft into the National Airspace System (NAS). It would be of great benefit in safety analysis and studies to insure that supplemental forms be used by investigators whenever possible. The information that can be gleaned from mishap reports is extremely valuable for safety purposes. Supplemental forms provide valuable information for safety studies.

6.3.2 Need for Additional NTSB Resources

The NTSB performs an extremely valuable service. It is also recognized that the NTSB must perform this service within budgetary constraints and that the same level of attention may not be given to each mishap. Therefore, it is important that the NTSB be provided with adequate funding to support their efforts. Mishap analysis and the resulting safety recommendations are cost beneficial to the community as well as to the aircraft industry. The fact that mishap analysis may lead to a reduction in the number of fatalities and/or injuries makes it extremely important that NTSB be provided additional resources for efforts to understand mishap causes. Currently, the detail available on rotorcraft mishaps is often skimpy. Without additional NTSB funding, this situation is not likely to improve.

6.3.3 Include Civil Incidents in Database

A significant distinction exists between the civilian and military mishap databases. While the military archives both accidents and incidents, the civil database contains primarily only accident information and very few incidents. The type of information obtained from incident reports used in this study emphasized the need for archiving incidents as well as accidents. While mishaps such as rotorwash incidents and minor obstruction strikes may not be costly in terms of lives or property damage, they do highlight possible design inadequacies and their overall importance to safety studies. Therefore, these occurrences are significant in the design and operational information they provide. A means of recording and archiving this information could be a significant aid in heliport design and operational guidance.

6.3.4 Public Service Mishaps

As of September 1988, Federal Regulation (49 CFR Part 830) requires operators of aircraft involved in "public use" mishaps to report these mishaps to the NTSB. This information is reported on Form 6120.1, the operator's reporting form. Even though this information is reported, NTSB is not authorized to investigate these mishaps unless requested by the agency involved in the mishap. Funding is limited for these purposes.

6.4 TAIL ROTOR PAINT SCHEMES

One manufacturer has indicated that tail rotor paint schemes can have an effect on the number of accidents involving tail rotor personnel strikes. This manufacturer stated that they had experienced a significant drop in the number of such accidents when they adopted a more visible paint scheme. The FAA should study tail rotor paint schemes to determine which is most visible while the tail rotors are turning.

6.5 FUTURE CONSIDERATIONS

This effort was designed to understand the manner in which heliport design may contribute to helicopter mishaps. From a review of the civilian and military mishap databases, it is apparent that landing site design does factor into a significant percentage of mishaps which occur on or near heliports and airports. Although not the major contributor to the overall number of helicopter mishaps, facility design related mishaps do result in financial and operational burdens to helicopter and facility owners, users, and operators. Therefore, instituting changes to reduce the number of facility design-related mishaps seems appropriate in light of the results of this study. Several suggestions have been included in the hopes of reducing design-related mishaps. The suggestions presented for recording mishap information would aid mishap studies and help to confirm the adequacy of design guidelines and standards presented in the Heliport Design Advisory Circular.

It would be beneficial to repeat this, or a similar effort, in about ten years to analyze the effectiveness of the recommendations herein in alleviating heliport mishaps. In addition, further research and development studies designed to investigate operational issues and to establish specific guidelines as to the minimum size of various operating areas and required obstruction clearances are needed. Such efforts provide valuable information concerning obstruction clearance and are extremely useful from a design viewpoint.

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LIST OF ACRONYMS

A/C	Aircraft
AC	Advisory Circular
AGL	Above Ground Level
CFR	Code of Federal Regulations
DOT	Department of Transportation
FAA	Federal Aviation Administration
FATO	Final Approach and Takeoff Area
FBO	Fixed Base Operator
FOIA	Freedom of Information Act
M/R	Main Rotor
NAS	National Airspace System
NOE	Nap-of-the-Earth
NTSB	National Transportation Safety Board
SOP	Standard Operating Procedures
T/R	Tail Rotor
VFR	Visual Flight Rules
WSPS	Wire Strike Protection System

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB Accident/Incident Number

Supplement G—Rotorcraft

1 Main Rotor Blade Type
1 ☐ Wood
2 ☐ Metal
3 ☐ Composite
A Other

2 Tail Rotor Blade Type
1 ☐ Wood
2 ☐ Metal
3 ☐ Composite
A Other

3 Auxiliary Fuel Tanks
1 ☐ None
2 ☐ Internal
3 ☐ External
A Other

4 IFR Certification
1 ☐ Single pilot
2 ☐ Dual Pilot IFR
3 ☐ None
A Other

5 Stability Augmentation System
1 ☐ Not installed
2 ☐ On
3 ☐ Off
4 ☐ On/off unknown
A Other

6 Engine Out Warning
1 ☐ Not installed
2 ☐ On
3 ☐ Off
4 ☐ On/off unknown
A Other

7 Low Rotor Speed Warning
1 ☐ Not installed
2 ☐ On
3 ☐ Off
4 ☐ On/off unknown
A Other

8 External Load Operations *(Multiple entry)*
1 ☐ Yes
2 ☐ No (Go to block 16)
3 ☐ Holds FAR 133 certificate
A Other

9 Type External Load Operation
1 ☐ Construction
2 ☐ Aerial Application
3 ☐ Logging
4 ☐ Medevac
5 ☐ Aerial survey
A Specify ____________
B Other

10 Long Line
1 ☐ Yes
2 ☐ No (Go to block 13)
A Other

11 Length of Long Line
________ Feet
A Other

12 Load Cell/Computer Utilized
1 ☐ Yes
2 ☐ No
A Other

13 Weight of External Load
1 ☐ Estimated
2 ☐ Verified
A ______ Lb
B Other

14 Load Jettisoned *(Multiple entry)*
1 ☐ External load
2 ☐ Long line
A Other

15 Landing Area *(Multiple entry)*
1 ☐ Level
2 ☐ Pinnacle
3 ☐ Confined area
A Slope ______ deg
B Other

16 Obstructions
1 ☐ Trees
2 ☐ Wires/poles
3 ☐ Buildings/construction
4 ☐ Equipment/vehicles
5 ☐ Terrain
A Specify
B Other

17 Component Separation in Flight *(Multiple entry)*
1 ☐ None
2 ☐ General disintegration
3 ☐ Tailboom/cone
4 ☐ Stabilizer
5 ☐ Main rotor blade(s)
6 ☐ Main rotor hub assembly
7 ☐ Tail rotor blade(s)
8 ☐ Tail rotor hub assembly
9 ☐ Main transmission
10 ☐ Intermediate gear box
11 ☐ Tail rotor gear box
12 ☐ Vertical fin/pylon
13 ☐ Skids/Float(s)
14 ☐ Door(s)
A Other

18 Component Separation Postimpact *(Multiple entry)*
1 ☐ None
2 ☐ General disintegration
3 ☐ Tailboom/cone
4 ☐ Stabilizer
5 ☐ Main rotor blade(s)
6 ☐ Main rotor hub assembly
7 ☐ Tail rotor blade(s)
8 ☐ Tail rotor hub assembly
9 ☐ Main transmission
10 ☐ Intermediate gear box
11 ☐ Tail rotor gear box
12 ☐ Vertical fin/pylon
13 ☐ Skids/Float(s)
14 ☐ Door(s)
A Other

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB Accident/Incident Number

Supplement Q Airport/Airstrip

1 Distance From Runway *(Multiple entry)*
1 ☐ On airport/airstrip or B Other
2 ☐ Approach end
3 ☐ Departure end
A Distance ______ NM

2 Bearing From Runway *(Multiple entry)*
1 ☐ On airport/airstrip or B Other
2 ☐ Approach end
3 ☐ Departure end
A Bearing ______ Mag

3 Type of Airport/Airstrip *(Multiple entry)*
1 ☐ Land
2 ☐ Water
3 ☐ Heliport
4 ☐ Other
5 ☐ Private use
6 ☐ Public use
A Other

4 Airport Category
1 ☐ Commercial service
2 ☐ Reliever
3 ☐ General aviation
A Other

5 Airport Certification (FAR 139)
1 ☐ Full certification
2 ☐ Limited certification
3 ☐ None *(Go to block 8)*
A Other

6 Emergency Plan Tested
1 ☐ Yes
2 ☐ No
A Other

7 Months Since Emergency Plan Tested
A Other

8 Instrument Approach to Active Runway *(Multiple entry)*
1 ☐ None
2 ☐ Nonprecision approach
3 ☐ Precision approach
4 ☐ CAT I
5 ☐ CAT II
6 ☐ CAT IIIA
7 ☐ CAT IIIB
A Other

9 Runway/Landing Surface Treatment *(Multiple entry)*
1 ☐ Porous
2 ☐ Smooth texture
3 ☐ Rough texture
4 ☐ Partially grooved
5 ☐ Fully grooved
A Other

10 Runway Overrun *(Declared)*
1 ☐ Yes
2 ☐ No
A Other

11 Length of Overrun
______ Feet
A Other

12 Displaced Threshold
1 ☐ Yes
2 ☐ No
A Other

13 Length of Displaced Threshold
______ Feet
A Other

14 Obstacles—Runway End to Airport/Airstrip Boundary *(Multiple entry)*
1 ☐ None
2 ☐ Approach lights
3 ☐ Approach/navaids
4 ☐ Building(s)
5 ☐ Wire(s)
6 ☐ Pole(s)
7 ☐ Tree(s)
8 ☐ Tower(s)
9 ☐ Dirt bank
10 ☐ Snow bank
11 ☐ Ditch
12 ☐ Water
13 ☐ Vertical drop
14 ☐ High terrain
A Other

15 Obstacles—Airport Boundary To 2 NM *(Multiple entry)*
1 ☐ None
2 ☐ Approach lights
3 ☐ Approach/navaids
4 ☐ Building(s)
5 ☐ Wire(s)
6 ☐ Pole(s)
7 ☐ Tree(s)
8 ☐ Tower(s)
9 ☐ Dirt bank
10 ☐ Snow bank
11 ☐ Ditch
12 ☐ Water
13 ☐ Vertical drop
14 ☐ High terrain
A Other

Airport/Airstrip Facilities

(Complete only those items which are pertinent to the accident/incident)	A Installed 1 Yes	2 No	B Functioning 1 Yes	2 No	C Used 1 Yes	2 No	D Other
18 VASI/VAPI							
19 Wind Direction Indicator							
20 Landing Direction Indicator							
21 Low Level Wind Shear Alert System							
22 Runway Barrier							
23 Runway Remaining Markers							
24 Tower							
25 UNICOM							
26 FSS							
27 ATIS							

National Transportation Safety Board

FACTUAL REPORT
AVIATION

NTSB Accident/Incident Number

Supplement Q—Airport/Airstrip (continued)

Airport/Airstrip Facilities *(Night or IMC)*
If the accident/incident occurred during approach, departure or on airport and it was night or IMC—complete those items which are considered pertinent to the occurrence.

Airport/Airstrip Facilities	A Installed 1 Yes	2 No	B Functioning 1 Yes	2 No	C Other
31 (ILS) Instrument Landing System—Complete					
32 ILS—Localizer Only					
33 ILS—Backcourse					
34 (MLS) Microwave Landing System					
35 VOR/TVOR					
36 VORTAC					
37 TACAN					
38 DME					
39 NDB					
40 (LOM) Locator Outer Marker					
41 Middle Marker					
42 Lighted Wind Indicator					
43 Approach Lights—Ground Actuated					
44 Approach Lights—Pilot Actuated					
45 Touchdown Zone Lights					
46 Threshold Lights					
47 Runway End Identifier Lights (REIL)					
48 Runway Edge Lights					
49 Runway Centerline Lights					
50 Taxiway Edge Lights					
51 Taxiway Centerline Lights					
52 Rotating Beacon					

National Transportation Safety Board

FACTUAL REPORT
AVIATION

NTSB Accident/Incident Number

Supplement Q—Airport/Airstrip (continued)

55 Type Approach Lights *(Runway used)*
1 ☐ ALSF-1
2 ☐ ALSF-2
3 ☐ SSALF
4 ☐ SSALR
5 ☐ MALSF
6 ☐ MALSR
7 ☐ LDIN
8 ☐ RAIL
9 ☐ ODALS
A Other

56 Type VASI *(Runway used)*
1 ☐ 2-bar
2 ☐ 3-bar
3 ☐ Tri-color
4 ☐ T-VASI
5 ☐ PLASI
A Other

57 Type Runway Edge Lights *(Runway used)*
1 ☐ LIRL
2 ☐ MIRL
3 ☐ HIRL
A Other

58 Runway Lights—Intensity/Setting
1 ☐ Low intensity
2 ☐ Medium
3 ☐ High
A Other

59 Point Where Aircraft Left Runway/Landing Surface *(Multiple entry)*
1 ☐ Approach end
2 ☐ Departure end
3 ☐ Left side
4 ☐ Right side
5 ☐ None
A Other

60 Departed Runway, Distance from Threshold
________ Feet
A Other

61 Type of Ground Contact on Runway Landing Surface
1 ☐ Touchdown
2 ☐ Impact
A Other

62 Point of Ground Contact
1 ☐ Approach end
2 ☐ Departure end

63 Ground Contact, Distance from Threshold
________ Feet
A Other

64 Ground Contact, Bearing from Threshold
________ Degrees magnetic
A Other

65 Point Where Aircraft Came to Rest, Distance From Runway Threshold
1 ☐ Approach end
2 ☐ Departure end
A ________ Feet
B Other

66 Point Where Aircraft Came to Rest, Relative Bearing from Runway Heading
________ deg
A Other

67 Runway Profile
1 ☐ Level
2 ☐ Up
3 ☐ Down
4 ☐ Down-up
5 ☐ Up-down
A Other

68 Average Slope Up
________ Percent grade
A Other

69 Average Slope Down
________ Percent grade
A Other

This section to be completed for all accidents incidents occurring during takeoff, approach or landing at a limited or full certification airport.

70 Runway RCR Recorded
1 ☐ No
A Yes-reading ________
B Other

71 Runway Friction Measuring Equipment
1 ☐ Available-used
2 ☐ Available not used
3 ☐ Not available
A Other

72 Type of Runway Friction Measuring Equipment
1 ☐ JBD
2 ☐ DBV
3 ☐ Friction meter
4 ☐ Mess...
5 ☐ Pi...
6 ☐ Vehicle
7 ☐ Skidometer
8 ☐ Tapley meter
9 ☐ Mu-meter
10 ☐ Estimate
A Other

73 Braking Action Report
1 ☐ No report
2 ☐ Good
3 ☐ Fair
4 ☐ Poor
5 ☐ Nil
A Other

74 Pilot Aware of Braking Action NOTAM
1 ☐ Yes
2 ☐ No
A Other

APPENDIX C

NTSB INVESTIGATOR'S REPORT FORM (1978 THROUGH 1981)

AIRCRAFT ACCIDENT ANALYSIS SHEET

FILE NUMBER/AIRCRAFT REGISTRATION

COLUMNS 1-14 TO BE PUNCHED ON ALL CARDS	FILE	REGISTRATION

CARD NO 00 IDENTIFYING INFORMATION

DATE | LOCATION | AIRCRAFT MAKE | AIRCRAFT MODEL | COLLISION | TIME OF OCCURRENCE

CARD NO 01 GENERAL INFORMATION

ALTITUDE OF OCCURRENCE | RECOVERY ALTITUDE | AIRCRAFT SPEED | OPERATOR

CARD NO 02

EMERGENCY CONDITIONS | WEATHER | AIRPORT INFORMATION

LATERAL DISTANCE FROM RUNWAY CENTERLINE | NAME OF AIRPORT | ELEVATION OF AIRPORT

CARD NO 03 FLIGHT ITINERARY

DEPARTURE POINT | LAST PLANNED ENROUTE LANDING POINT | INTENDED DESTINATION

CARD NO 04

ACCIDENT SITE | MISC DATA | PILOT DATA

HOURS, TOTAL | HOURS IN TYPE | AGE | RATING

CARD NO 05 CAUSE/FACTOR

CARD NO 08 INJURIES

PILOT IN COMMAND | COPILOT | DUAL STUDENT

F C M N T

CARD NO 09 INJURIES

CHECK PILOT | FLIGHT ENGINEER | NAVIGATOR

F C M N T

CARD NO 10 INJURIES

CABIN ATTENDANT | EXTRA CREW | PASSENGERS

F C M N T

CARD NO 11 INJURIES

TOTAL ABOARD | OTHER (AIRCRAFT) | OTHER (GROUND) | PILOT PROF DATA | RUNWAY IN USE

F C M N T

CARD NO 12 INJURIES

GRAND TOTAL | FAA PERSONNEL | NTSB PERSONNEL

F C M N T

CARD NO 13 INJURIES

OTHER GOVERNMENT

F C M N T

CARD NO 14 REMARKS

CARD NO. 15

SPECIAL DATA

CARD NO 17

- Partial power loss (engine)
- Complete failure (engine)
- Simulated flameout (eng. shut-down)
- Propellers - Part I
- Propellers - Part II
- Engine seizure

TIME SINCE NEW OR LAST OVERHAUL

- Airframe
- #1 Engine (or single engine)
- #2 Engine
- #3 Engine
- #4 Engine
- #1 Propeller
- #2 Propeller
- #3 Propeller
- #4 Propeller
- Aircraft - total time
- Aircraft serial number

CARD NO 18

- Cloud condition

WEATHER AT ACCIDENT SITE

- Ceiling
- Visibility
- Precipitation
- Obstructions to vision
- Wind component (rel. brg. of wind)
- Temperature/dew point spread
- Runway visual range
- General weather
- Temperature
- Wind direction
- Wind velocity

APPROACH AIDS AVAILABLE

- Precision approach (PAR)
- Surveillance approach (ASR)
- Inst land sys (ILS) complete sys
- ILS - glide path only
- Localizer only
- Visual approach slope indicator
- TACAN
- VOR - (VOR)
- Non-directional radio beacon
- Low freq radio range
- Approach lighting (available)
- Approach lighting system
- Land. wx. minima (categories)

CARD NO 19

PILOT IN COMMAND DATA

- Instrument time, actual
- Instrument time, simulated
- Simulator time (type involved)
- Actual instrument time (last 30 days)
- Night time (total)
- Pilot time (last 24 hours)
- Pilot time (last 30 days)
- Pilot time last 90 days
- Duration this flight
- On duty time
- Rest period prior to flight

CARD NO 20

- Results of toxicology examination (pilot)
- Alcohol content - range (pilot only)
- Impact severity
- Impact angle
- Rate of deceleration
- Direction of principal deceleration
- Stopping distance
- Damage severity - cockpit
- Damage severity - fwd cabin
- Damage severity - ct cabin
- Damage severity - aft cab
- Damage sev. - impact (non-flame type act.)
- Seating configuration
- Seat failures - numerical summary
- Seat belt failures - numerical summary
- Deaths resulting from fire after impact

EVACUATION DATA

- Evacuation chute/slide
- Rope
- Ladder
- Emergency exits
- Emergency lights (act.)
- Outside assistance
- Means or method of exit
- Occupants - evacuated - numerical summary
- Occupants - not evacuated
- Evacuation time
- Attitude at impact (roll, pitch, yaw)
- Speed at impact
- Autopsy toxicology

CARD NO 21

FIRE INFORMATION

- Aircraft fire extinguisher system
- Fire warning system
- Location of fire
- Cabin fire-fighting system
- (Acft. used)
- (Not acft. used)
- Ground
- Fumes
- Fire damage (act.)
- Ground fire fighting equipment

EQUIPMENT INSTALLED/WT & BAL

- Auto pilot
- Approach coupler
- Flight recorder
- Radar (airborne weather)
- Transp.
- Anti-icing / De-icing
- Windshield
- Stall warning indicator
- Gross weight
- Center of gravity
- WT & BAL
- Property damage
- Emergency locator transmitter
- Stability augmentation
- Cockpit voice recorder
- Electric command control system
- Inertial navigation control sys
- Airborne integrated data sys
- Maint. & defect analysis recorder
- Heads-up display

CARD NO 22

- Investigator in charge (initials)
- Type of accident release
- Date investigation report available for analysis
- Date - analysis completed
- Analyst number
- Data classification
- Accident/incident identification number

AFTSA FORM 6120.13 (Rev. 11/76) ■ LEFT OR RIGHT ADJUST DATA FIELD DO NOT ZERO FILL RIGHT ADJUSTED DATA FIELDS

PAGE NO. 3 CODED ... OF CODED

SPECIAL DATA

CARD NO. 26 AERIAL APPLICATION

- PILOT TIME-CROP CONTROL
- KIND OF OPERATION
- KIND OF CROP
- TYPE OF CHEMICAL USED
- TOXIC EFFECT-EXPOSURE
- DURATION OF EXPOSURE
- TOXIC ANTIDOTE
- SHOULDER HARNESS
- SEAT BELT
- PROTECTIVE EQUIPMENT:
  - RESPIRATION
  - SPECIAL CLOTHING
  - GLOVES
  - GOGGLES
  - CRASH HELMET
  - COCKPIT CRASH PAD
  - CRASH BAG
- TANK/HOPPER-LOCATION
- ELEVATION-AREA OF END RELATED
- OBSTRUCTIONS
- TERRAIN TYPE
- SWATH RUN-HOW FLOWN
- PROCEDURE TURNAROUND

13	14	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
2	6																																	

CARD NO. 27 COLLISION BETWEEN AIRCRAFT (THIS AIRCRAFT)

- SEGMENTS OF AVIATION INVOLVED
- TERMINAL COMMUNICATION ESTABLISHED
- UNDER CONTROL OF
- RADAR CONTROL/SURVEILLANCE
- TRAFFIC ADVISORY ISSUED
- CONTROLLED/UNCONTROLLED AIRPORT
- CONTROL ZONE/AREA
- DIRECTION OF FLIGHT
- CONVERGENCE ANGLE
- COLLISION ANGLE-HORIZONTAL
- COLLISION ANGLE-VERTICAL
- EVASIVE ACTION TAKEN
- ANTI COLLISION LIGHTS
- INSTRUMENT TRAINING OPERATIONS
- MILITARY INVOLVEMENT
- MILITARY TYPE

13	14	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
2	7																								

DATE

LOCATION

REGISTRATION NUMBER

CARD NO. 28 DITCHING-SURVIVAL

- SURFACE COND-DITCHING IN WATER
- WATER TEMPERATURE
- TIME IN WATER (NOT IN RAFT)
- TIME IN RAFT PRIOR TO RESCUE
- DISTRESS CALL RECEIVED FROM ACFT
- AIRCRAFT SANK/STAYED AFLOAT
- LIFE PRESERVER
- LIFE RAFT
- FLARES (DISTRESS)
- DYE MARKER
- FLASHLIGHT
- MIRROR
- RADIO (EMERGENCY)

13	14	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2	8																		

NTSB FORM 6120.13 (Rev. 11/76) ENTER DIRECT ■ LEFT OR RIGHT ADJUST DATA FIELD. DO NOT ZERO FILL RIGHT ADJUSTED DATA FIELDS.

APPENDIX D
NTSB INVESTIGATOR'S REPORT FORM (1982)

NTSB ACCIDENT/INCIDENT REPORT

6120.4D

DATE OF ACCIDENT

__ __ __ __ __ __
Month **Day** **Year**

STATE OF OCCURRENCE

__ __

AIRCRAFT REGISTRATION "N" NUMBER

____

CLASSIFICATION

☐ **Accident**

☐ **Incident**

NTSB ACCIDENT/INCIDENT NUMBER

__ __ __ __ __ __ __ __ __ __

AIRCRAFT INFORMATION

BASIC AIRCRAFT DATA				
	1 AIRCRAFT REGISTRATION #	2 AIRCRAFT MANUFACTURER	3 AIRCRAFT MODEL	4 AIRCRAFT SERIAL #
	5 MAXIMUM GROSS WEIGHT	6 YEAR MANUFACTURED	7 NUMBER OF SEATS	8 NUMBER OF ENGINES

9 AIRCRAFT REGISTRY [ ] U.S. [ ] Foreign [ ] Other — 10 HOMEBUILT [ ] Yes [ ] No [ ] Other

11 LANDING GEAR
[ ] Tricycle - Fixed [ ] Tailwheel - All Retract [ ] Hull [ ] Skid
[ ] Tricycle - Retractable [ ] Tailwheel Fixed - Mains Retract [ ] Float [ ] Ski/wheel
[ ] Tailwheel - All Fixed [ ] Amphibian [ ] Ski [ ] Other

POWERPLANT(S) and PROPELLER(S) 12 [ ] NONE INSTALLED (If this block is checked do not complete 13-16,25,34-35)

13 ENGINE TYPE
[ ] Reciprocating - Carburetor [ ] Turboprop [ ] Turbofan
[ ] Reciprocating - Fuel Injected [ ] Turbojet [ ] Turboshaft [ ] Other

ENGINE MAKE/ MODEL	14 ENGINE MANUFACTURER	15 ENGINE MODEL	16 ENGINE RATED POWER [ ] Horsepower [ ] Lbs. Thrust

25 PROPELLER TYPE
[ ] Fixed - Wood [ ] Constant Speed/Controllable Pitch [ ] Full Automatic Feathering
[ ] Fixed - Metal [ ] Ground Adjustable/Variable Pitch [ ] Full Manual Feathering
[ ] Fixed - Composite [ ] Reversable [ ] Other

32 TOTAL AIRFRAME TIME ______ Hrs [ ] Other [ ] Tach [ ] Flight [ ] Other
33 TIME SINCE INSPECTION ______ Hrs [ ] Other [ ] Tach [ ] Flight [ ] Other

	#1 Engine	#2 Engine	#3 Engine	#4 Engine	#1 Prop	#2 Prop	#3 Prop	#4 Prop
34 TSI								
35 TSO								

44 FUEL TYPE(S)
[ ] 80/87 [ ] 115/145 [ ] Kerosene [ ] Jet A [ ] Automotive Gasoline [ ] Anti-ice Additive Added
[ ] 100/130 [ ] 100 LL [ ] JP 3,4,5,6 [ ] Jet B [ ] Mixture [ ] Other

77 AIRCRAFT DAMAGE [ ] Destroyed [ ] Substantial [ ] Minor [ ] None [ ] Other

78 FIRE IN-FLIGHT [ ] Yes [ ] No [ ] Other — 79 FIRE ON GROUND [ ] Yes [ ] No [ ] Other

112 STALL WARNING INDICATING SYSTEM INSTALLED [ ] Yes [ ] No [ ] Other

113 TYPE OF STALL WARNING INDICATOR [ ] Visual/Light [ ] Visual/Gauge [ ] Aural [ ] Stickshaker [ ] Other

114 STALL WARNING CAPABLE OF OPERATION [ ] Yes [ ] No [ ] Other

117 WEATHER RADAR INSTALLED [ ] Yes [ ] No [ ] Other

118 TYPE OF WEATHER RADAR [ ] Storm Detection [ ] Black and White [ ] Color [ ] Other

119 RADAR OPERATED SATISFACTORILY [ ] Yes [ ] No [ ] Other

137 ELT INSTALLED [ ] Yes [ ] No [ ] Other — 138 ELT REQUIRED [ ] Yes [ ] No [ ] Other

140 BEFORE IMPACT ELT WAS LOCATED IN [ ] Cockpit [ ] Cabin [ ] Empennage [ ] Raft [ ] Survival Kit [ ] Other

Type of ELT	141 # ON A/C	142 # ACTIVATED Auto	Man	Water	Other	143 # FAILED	# Other	144 REASON FOR NONEFFECTIVENESS/ FAILURE
Fixed								
Personnel								

ENVIRONMENT/OPERATIONS

LOCATION OF ACCIDENT/INCIDENT

300 CITY ☐ Other

301 STATE __ __ ☐ Other

302 ZIP CODE ☐ Other

303 ☐ ON AIRPORT 304 ☐ ON AIRSTRIP 305 ☐ OFF AIRPORT/AIRSTRIP

306 AIRPORT IDENTIFIER ☐

307 AIRPORT NAME ☐ Other

☐ Within 5 NM

☐ 5 NM or Greater

☐ Other

DATE OF ACCIDENT/INCIDENT

308 DATE OF ACCIDENT/INCIDENT ☐ Other

__ __ Month __ __ Day __ __ Year

309 DAY OF WEEK ☐ Other __ __

310 TIME (LOCAL) ☐ Other __ __ __ __

311 TIME ZONE ☐ Other __ __ T

ITINERARY

312 LAST DEPARTURE POINT ☐ Other

☐ Same as Acc/Inc Location OR

☐ ______________ __ __

☐ Airport Identifier ☐ City State

313 TIME (LOCAL) ☐ Other __ __ __ __

314 DESTINATION ☐ Other

☐ Local OR

☐ ______________ __ __

☐ Airport Identifier ☐ City State

REGISTERED A/C OWNER

315 NAME ☐ Other

316 ADDRESS ☐ Other

OPERATOR OF AIRCRAFT

317 NAME ☐ Other

☐ Same as Above __ __ __

dba

318 ADDRESS ☐ Other

☐ Same as Above

319 OPERATOR STATUS THIS AIRCRAFT ☐ Owner ☐ Lessee ☐ Renter ☐ Borrower ☐ Unauthorized ☐ Other

320 PROPERTY DAMAGE ☐ None ☐ Residential Area ☐ Airport Facility ☐ Crops ☐ Residence ☐ Commercial Bldg. ☐ Vehicle ☐ Trees ☐ Other

(Only complete data fields 333-335 if the acc/inc occurred on an airport/airstrip or the aircraft was in the takeoff, approach, landing, or appropriate maneuvering phase of operation.)

333 RUNWAY IDENTIFIER __ __ ☐ Other | 334 RUNWAY LENGTH ______ Ft ☐ Other | 335 RUNWAY WIDTH ______ Ft ☐ Other

(Only complete data fields 350-352 if the acc/inc occurred during the takeoff, approach, landing, or appropriate maneuvering phase of operation.)

350 RUNWAY SURFACE TYPE ☐ Macadam ☐ Concrete ☐ Asphalt ☐ Gravel ☐ Dirt ☐ Grass/Turf ☐ Snow ☐ Ice ☐ Water ☐ Other

351 RUNWAY SURFACE CHARACTERISTICS ☐ Grooved ☐ Porous ☐ Smooth Texture ☐ Rough Texture ☐ Partially Grooved ☐ Fully Grooved ☐ Other

352 RUNWAY SURFACE STATUS
☐ Dry ☐ Water Covered ☐ Snow Crusted ☐ Water - Calm ☐ Rubber Deposits ☐ Slush
☐ Wet ☐ Snow - Dry ☐ Snow - Compacted ☐ Water - Choppy ☐ Soft ☐ Holes
☐ Ice ☐ Snow - Wet ☐ Vegetation ☐ Water - Glassy ☐ Rough ☐ Other

375 TYPE OF FLIGHT PLAN ☐ None ☐ VFR ☐ IFR ☐ VFR/IFR ☐ Other

376 TYPE OF CLEARANCE ☐ None ☐ Special VFR ☐ Controlled VFR ☐ VFR On Top ☐ VFR Flight Following ☐ Tower ☐ Radar Advisories ☐ Other

378 TYPE OF APPROACH FLOWN
☐ None ☐ Visual Full Circuit ☐ Visual Straight-in ☐ Contact ☐ Touch and Go ☐ Stop and Go
☐ NDB ☐ TACAN ☐ RNAV ☐ MLS ☐ LDA ☐ VOR/TVOR ☐ ASR ☐ PAR ☐ Circling ☐ VOR/DME
☐ VORTAC ☐ ADF ☐ LFR ☐ DF ☐ ILS - Complete ☐ ILS - Localizer Only ☐ ILS - Backcourse
☐ Practice ☐ Sidestep ☐ ARA Assisted ☐ Radar Monitored ☐ Parallel Monitored ☐ Other

PRE-FLIGHT WEATHER BRIEFING	400 SOURCE	☐ No Record of Briefing ☐ Briefing Received - Source Unknown ☐ NWS ☐ FSS ☐ PATWAS ☐ VRS - Computer ☐ Company ☐ Commercial Weather Service ☐ TV Wx ☐ Military ☐ Other
	401 METHOD	☐ In Person ☐ Telephone ☐ Radio ☐ TV ☐ Other
	402 COMPLETENESS	☐ Full ☐ Self ☐ Partial Limited By Forecaster ☐ Partial Limited By Pilot ☐ Other

WEATHER CONDITIONS AT ACCIDENT SITE

420 CONDITION OF LIGHT ☐ Dawn ☐ Daylight ☐ Night (Dark) ☐ Night (Bright) ☐ Dusk ☐ Other

INVESTIGATOR'S SOURCE OF WEATHER DATA	421 WITNESS	422 WEATHER OBSERVATION FACILITY
	☐ Holds Aeronautical Rating	Identifier ______ Time of Observation ______
	☐ No Rating Held	Distance ______ NM ☐ At Site Direction ______ ° ☐ At Site

423 BASIC WEATHER CONDITIONS ☐ VMC ☐ IMC ☐ Other | 424 PRECIPITATION ☐ Yes ☐ No ☐ Other

425 VISIBILITY ______ SM ☐ Other RVV ______ Ft RVR ______ F.

426 WIND DIRECTION ______ ° ☐ Variable ☐ Other | 427 WIND SPEED ______ Kts ☐ Calm ☐ Other

428 TEMPERATURE ______ °F ☐ Other | 430 ALTIMETER SETTING ______ " ☐ Other

432 FIRST CLOUD CONDITION ☐ None(Clr) OR ______ Ft ☐ Sct ☐ Bkn ☐ Ovc ☐ -X ☐ X ☐ Indefinite ☐ Other

433 SECOND CLOUD CONDITION ☐ None(Clr) OR ______ Ft ☐ Sct ☐ Bkn ☐ Ovc ☐ -X ☐ X ☐ Indefinite ☐ Other

434 OBSTRUCTIONS TO VISION ☐ None ☐ Dust(D) ☐ Fog(F) ☐ Ground Fog(GF) ☐ Blowing Spray(BY) ☐ Blowing Sand(BN) ☐ Haze(H) ☐ Smoke(K) ☐ Ice Fog(IF) ☐ Blowing Snow(BS) ☐ Blowing Dust(BD) ☐ Other

435 TYPE OF PRECIPITATION ☐ Rain(R) ☐ Rain Shower(RW) ☐ Ice Pellets(IP) ☐ Freezing Rain(ZR) ☐ Ice Pellet Shower(IPW) ☐ Snow(S) ☐ Snow Shower(SW) ☐ Snow Pellets(SP) ☐ Freezing Drizzle(ZL) ☐ Hail(A) ☐ Drizzle(L) ☐ Snow Grains(SG) ☐ Ice Crytals(IC) ☐ Other

436 INTENSITY OF PRECIPITATION ☐ Light ☐ Medium ☐ Heavy ☐ Other

INJURY SUMMARY

500	Fatal	Serious	Minor	None	Unknown	Total	DATE OF BIRTH
Pilot in Command							__ __ / __ __ / __ __
Copilot							__ __ / __ __ / __ __
Student Pilot (Dual)							__ __ / __ __ / __ __
Instructor							__ __ / __ __ / __ __
Flight Engineer							__ __ / __ __ / __ __
Loadmaster							Month Day Year
Other Cockpit Crew							
Cabin Crew							
Passengers							
Total On Aircraft							
Other Ground							
Other Aircraft							
Total For Acc/Inc							
FAA							
NTSB							

PILOT IN COMMAND DATA

501 PILOT NAME ☐ Other | 502 PILOT CERTIFICATE # ☐ Other

504 AGE ______ Yrs ☐ Other | 505 SEX ☐ M ☐ F ☐ Other

511 CERTIFICATE(S) ☐ Student ☐ Commercial ☐ Flight Instructor (If checked complete 519) ☐ Foreign ☐ Private ☐ Airline Transport ☐ None ☐ Military ☐ Other

512 RATING(S)
- Airplane: ☐ SE Land ☐ SE Sea ☐ ME Land ☐ ME Sea
- Rotorcraft: ☐ Helicopter ☐ Gyroplane
- ☐ Glider
- Lighter Than Air: ☐ Airship ☐ Free Balloon

513 INSTRUMENT RATING(S) ☐ None ☐ Airplane ☐ Helicopter ☐ Other

BIENNIAL FLIGHT REVIEW
- 514 BFR(Or Equivalent) ☐ Yes ☐ No ☐ Other | 515 MONTHS SINCE BFR(Or Equivalent) ______ ☐ Other
- 516 BFR(Or Equivalent) AIRCRAFT MAKE/MODEL - ☐ Other

517 AIRCRAFT TYPE RATING ☐ Yes ☐ No ☐ Other | 518 MONTHS SINCE TYPE RATING FLIGHT CHECK ______ ☐ Other

519 INSTRUCTOR RATING(S)
- Airplane: ☐ Single Engine ☐ Multi-engine
- Rotorcraft: ☐ Helicopter ☐ Gyroplane
- ☐ Glider
- Instrument: ☐ Airplane ☐ Helicopter
- Ground Instructor: ☐ Yes ☐ No ☐ Other

520 SOURCE OF FLIGHT TIME ☐ Pilot Log ☐ Company ☐ FAA Records ☐ Operator ☐ Estimate ☐ Relative ☐ Other

521 FLIGHT TIME	ALL A/C	THIS MAKE/ MODEL	MULTI-ENGINE	INSTRUMENT ACTUAL	INSTRUMENT SIMULATED	ROTOR-CRAFT	GLIDER	LIGHTER THAN AIR
TOTAL								
PIC								
INSTRUCTOR								
THIS MAKE/MODEL								
LAST 90 DAYS								
LAST 30 DAYS								
LAST 24 HOURS								

522 LANDINGS LAST 90 DAYS - ALL AIRCRAFT | DAY ☐ Other | NIGHT ☐ Other

523 LANDINGS LAST 90 DAYS - THIS M/M | DAY ☐ Other | NIGHT ☐ Other

524 PRIOR EXPERIENCE IN GEOGRAPHIC AREA LAST YEAR ☐ Yes ☐ No ☐ Other

525 PRIOR EXPERIENCE AT AIRPORT/AIRSTRIP LAST YEAR ☐ Yes ☐ No ☐ Other

RECENCY OF MANEUVER	# Done #	# Done Other	Weeks Since #	Weeks Since Other	Flight Hrs Since #	Flight Hrs Since Other	Done On Flight Check Yes	Done On Flight Check No	Done On Flight Check Other	Done On BFR Y	Done On BFR N	Done On BFR Other
545 TAILWHEEL LANDING												
546 GO-AROUND												
549 INSTRUMENT APPROACH												
550 STALL PRACTICE												
553 SIMULATED/ACTUAL FORCED LANDING												

PILOT IN COMMAND (Continued)

564 MEDICAL CERTIFICATE ☐ Valid Medical - No Waiver/Limitations ☐ Valid Medical - With Waivers/Limitations ☐ Non-Valid Medical ☐ No Medical ☐ Other

565 MEDICAL CERTIFICATE CLASS ☐ I ☐ II ☐ III ☐ Other | 566 DATE OF LAST MEDICAL ____ Month ____ Day ____ Year ☐ Other

567 WAIVER ☐ Vision ☐ Hearing ☐ Other | 568 LIMITATION ☐ Vision ☐ Hearing ☐ Other

COPILOT/DUAL STUDENT DATA 625 ☐ NONE ON AIRCRAFT (Do not complete data fields 626-693)

626 PILOT NAME ☐ Other | 627 PILOT CERTIFICATE # ☐ Other

629 AGE ________ Yrs ☐ Other | 630 SEX ☐ M ☐ F ☐ Other

636 CERTIFICATE(S) ☐ Student ☐ Commercial ☐ Flight Instructor (If checked complete 644) ☐ Foreign ☐ Private ☐ Airline Transport ☐ None ☐ Military ☐ Other

637 RATING(S)
- Airplane: ☐ SE Land ☐ SE Sea ☐ ME Land ☐ ME Sea
- Rotorcraft: ☐ Helicopter ☐ Gyroplane
- ☐ Glider
- Lighter Than Air: ☐ Airship ☐ Free Balloon

638 INSTRUMENT RATING(S) ☐ None ☐ Airplane ☐ Helicopter ☐ Other

BIENNIAL FLIGHT REVIEW
- 639 BFR (Or Equivalent) ☐ Yes ☐ No ☐ Other | 640 MONTHS SINCE BFR (Or Equivalent) ________ ☐ Other
- 641 BFR (Or Equivalent) AIRCRAFT MAKE/MODEL - ☐ Other

642 AIRCRAFT TYPE RATING ☐ Yes ☐ No ☐ Other | 643 MONTHS SINCE TYPE RATING FLIGHT CHECK ________ ☐ Other

644 INSTRUCTOR RATING(S)
- Airplane: ☐ Single Engine ☐ Multi-engine
- Rotorcraft: ☐ Helicopter ☐ Gyroplane
- ☐ Glider
- Instrument: ☐ Airplane ☐ Helicopter
- Ground Instructor: ☐ Yes ☐ No ☐ Other

645 SOURCE OF FLIGHT TIME ☐ Pilot Log ☐ Company ☐ FAA Records ☐ Operator ☐ Estimate ☐ Relative ☐ Other

646 FLIGHT TIME	ALL A/C	THIS MAKE/MODEL	MULTI-ENGINE	INSTRUMENT ACTUAL	INSTRUMENT SIMULATED	ROTOR-CRAFT	GLIDER	LIGHTER THAN AIR
TOTAL								
PIC								
INSTRUCTOR								
THIS MAKE/MODEL								
LAST 90 DAYS								
LAST 30 DAYS								
LAST 24 HOURS								

647 LANDINGS LAST 90 DAYS - ALL AIRCRAFT DAY ☐ Other NIGHT ☐ Other

648 LANDINGS LAST 90 DAYS - THIS M/M DAY ☐ Other NIGHT ☐ Other

649 PRIOR EXPERIENCE IN GEOGRAPHIC AREA LAST YEAR ☐ Yes ☐ No ☐ Other

650 PRIOR EXPERIENCE AT AIRPORT/AIRSTRIP LAST YEAR ☐ Yes ☐ No ☐ Other

COPILOT/DUAL STUDENT (Continued)

RECENCY OF MANEUVER	# Done #	# Done Other	Weeks Since #	Weeks Since Other	Flight Hrs Since #	Flight Hrs Since Other	Done On Flight Check Yes	Done On Flight Check No	Done On Flight Check Other	Done On BFR Y	Done On BFR N	Done On BFR Other
670 TAILWHEEL LANDING												
671 GO-AROUND												
674 INSTRUMENT APPROACH												
675 STALL PRACTICE												
678 SIMULATED/ACTUAL FORCED LANDING												

689 MEDICAL CERTIFICATE ☐ Valid Medical - No Waivers/Limitations ☐ Valid Medical - With Waivers/Limitations ☐ Non-Valid Medical ☐ No Medical ☐ Other

690 MEDICAL CERTIFICATE CLASS ☐ I ☐ II ☐ III ☐ Other

691 DATE OF LAST MEDICAL ___ Month ___ Day ___ Year ☐ Other

692 WAIVER ☐ Vision ☐ Hearing ☐ Other

693 LIMITATION ☐ Vision ☐ Hearing ☐ Other

NAMES OTHER CREWMEMBERS	NAMES OTHER OCCUPANTS And GROUND PERSONNEL

NARRATIVE STATEMENT OF PERTINENT FACTS, CONDITIONS, AND CIRCUMSTANCES (Continue on additional sheets as necessary)

INVESTIGATED BY: SIGNATURE	AGENCY	DATE

NTSB FACTUAL REPORT FORM (1983 THROUGH 1986)

National Transportation Safety Board

FACTUAL REPORT
AVIATION

1 NTSB Accident/Incident Number

2
1 Accident
2 Incident

3 Investigation
1 NTSB
2 FAA Delegated

4 Aircraft Registration Number	5 Flight Number A Other	For collision between aircraft, enter reg. no. and flt. no. for other aircraft	6 Aircraft Registration Number	7 Flight Number A Other

8 Nearest City/Place	9 State	10 Zip Code (First 5 numbers only)	11 Accident Site Elevation ______ Feet MSL

12 Date of Accident (Nos. for M. D. Y)	13 Day of Week (First 3 letters)	14 Local Time (24 hour clock)	15 Time Zone

16 Narrative Statement of Facts, Conditions and Circumstances Pertinent to the Accident/Incident

STORED IN THE SEPARATE
NARRATIVE
DATA BASE

Additional Persons Participating in this Accident/Incident Investigation (Name, address, affiliation. Continue on page 2 if necessary)

17 Date (Nos. for M, D, Y)	18 Agency	19 Name/Signature

NTSB Form 6120.4 (Rev. 1-84)

National Transportation Safety Board

FACTUAL REPORT
AVIATION

NTSB Accident/Incident Number

Airport/Approach/Landing Information

24 [ ] Not applicable *(Go to block 39)*

25 Airport Name
____
A Other

26 Airport Identifier
____

27 Accident Location
1 [ ] Off airport/airstrip
2 [ ] On airport
3 [ ] On airstrip
A Other

28 Distance From Airport Center *(Nearest SM)*
________ SM
A Other

29 Direction From Airport
________ °mag
A Other

30 VFR Approach/Landing *(Multiple entry)*
1 [ ] None
2 [ ] Traffic pattern
3 [ ] Straight-in
4 [ ] Valley/terrain following
5 [ ] Go around
6 [ ] Touch and go
7 [ ] Full stop
8 [ ] Stop and go
9 [ ] Simulated forced landing
10 [ ] Forced landing
11 [ ] Precautionary landing
A Other

31 Type Instrument Approach Flown *(Multiple entry)*
1 [ ] None
2 [ ] ADF/NDB
3 [ ] SDF
4 [ ] VOR/TVOR
5 [ ] VOR/DME
6 [ ] TACAN
7 [ ] ILS-complete
8 [ ] ILS-localizer
9 [ ] ILS-backcourse
10 [ ] RNAV
11 [ ] MLS
12 [ ] LDA
13 [ ] ASR
14 [ ] PAR
15 [ ] Sidestep
16 [ ] Visual
17 [ ] Contact
18 [ ] Circling
19 [ ] Practice
A Other

32 Runway Used Identifier
____
A Other

33 Runway Length
________ Feet
A Other

34 Runway Width
________ Feet
A Other

35 Airport Elevation
________ Ft MSL
A Other

36 Runway/Landing Surface
1 [ ] Macadam
2 [ ] Asphalt
3 [ ] Concrete
4 [ ] Gravel
5 [ ] Dirt
6 [ ] Grass/turf
7 [ ] Snow
8 [ ] Ice
9 [ ] Water
10 [ ] Metal/wood
A Other

37 Runway/Landing Surface Condition
1 [ ] Dry
2 [ ] Wet
3 [ ] Ice covered
4 [ ] Snow—dry
5 [ ] Snow—wet
6 [ ] Snow—crusted
7 [ ] Snow—compacted
8 [ ] Vegetation
9 [ ] Water—calm
10 [ ] Water—choppy
11 [ ] Water—glassy
12 [ ] Rubber deposits
13 [ ] Soft
14 [ ] Rough
15 [ ] Slush covered
16 [ ] Holes
A Other

If accident occurred during approach, departure or on airport, see instructions for completing Supplement Q.

Aircraft Information

39 Aircraft Manufacturer

40 Aircraft Model/Series

41 Serial No.
____
A Other

42 Certificated Maximum Gross Weight
____
A Other

43 Type of Aircraft
1 [ ] Airplane
2 [ ] Helicopter
3 [ ] Glider
4 [ ] Balloon
5 [ ] Blimp/dirigible
6 [ ] Ultralight
7 [ ] Gyroplane
A Specify
____

44 Type Airworthiness Certificate *(Multiple entry)*
Standard
1 [ ] Normal
2 [ ] Utility
3 [ ] Acrobatic
4 [ ] Transport
Special
5 [ ] Restricted
6 [ ] Limited
7 [ ] Provisional
8 [ ] Special flight
9 [ ] Experimental
A Other

45 Home Built
1 [ ] Yes
2 [ ] No
A Other

NTSB Accident/Incident Number

National Transportation Safety Board

FACTUAL REPORT AVIATION

Aircraft Information (continued)

46 Landing Gear *(Multiple entry)*
1 Tricycle—fixed
2 Tricycle—retractable
3 Tailwheel—all fixed
4 Tailwheel—all retractable
5 Tailwheel—retractable mains
6 Amphibian
7 Hull
8 Float
9 Emerg. float
10 Ski
11 Ski/wheel
12 Skid
13 High Skid
A Other

48 No. of Seats
A Other

49 Stall Warning System Installed
1 Yes
2 No
A Other

50 IFR Equipped
1 Yes
2 No
A Other

51 Icing Certification/Equipped *(Multiple entry)*
1 Certified
2 Not Certified
3 Equipped
4 Not Equipped
A Other

52 Engine Type
1 Reciprocating—carburetor
2 Reciprocating—fuel injected
3 Turbo prop
4 Turbo jet
5 Turbo fan
6 Turbo shaft
A Other

If not Engine powered go to block 59

53 Engine Manufacturer

54 Engine Model and Series

55 Engine Rated Power
A ________ Horsepower
B ________ Lbs. Thrust
C Other

56 Number of Engines
A Other

If 3 or more engines enter times in Supp. C

Engine Time (Hours)	A Total Time	B Time Since Inspection	C Time Since Major Overhaul	D Other
57 Engine No. 1				
58 Engine No. 2				

59 Type Maintenance Program
1 Annual
2 Manufacturer's Inspection Program
3 Other approved inspection program (AAIP)
4 Continuous airworthiness
A Other

60 Type of Last Inspection
1 Annual
2 100 hour
3 AAIP
4 Continuous airworthiness
A Other

61 Date Last Inspection Performed
(Nos. for M D Y)
A Other

62 Time Since Inspection
________ Hours
A Other

63 Airframe Total Time
________ Hours
A Other

64 Source of Maintenance Information
1 Tach
2 Flight
3 Hobbs
4 Logbooks Records
5 Estimate
6 Pilot/Operator Report
A Other

65 Hazardous Materials on Aircraft
1 No
A (Type) ________
B Other

Emergency Locator Transmitter (ELT)	1 Yes	2 No	A Other
67 Installed			
68 Required			
69 Operated			
70 Aided in location of accident site			

66 Hazardous Material Spill/Factor
1 Yes
2 No
A Other

Owner/Operator Information

71 Registered Aircraft Owner
Name

72 Address

73 Operator of Aircraft 1 ___ Same as registered owner
A Name
B dba
C Other

74 Address 1 ___ Same as registered owner
A ________
B Other

75 Operator Certificate No.
A Other

76 Operator Designator Code

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB Accident/Incident Number

Owner/Operator Information *(continued)*

77 Operator Status of This Aircraft
1 Owner
2 Lessee
3 Renter
4 Borrower
5 Unauthorized
A Other

78 Pilot Status of This Aircraft
1 Owner
2 Lessee
3 Renter
4 Borrower
5 Unauthorized
6 Employee
A Other

Type of Certificate(s) Held

79 None *(Go to block 83)*

80 Air Carrier Operating Certificate *(Check all applicable)*
1 Flag carrier/domestic (121)
2 Supplemental
3 All cargo (418)
4 Large helicopter (127)
5 Commuter air carrier
6 On-demand air taxi

81 Operating Certificate
Other operator of large aircraft

82 Operator Certificate
1 Rotorcraft—external load operator (133)
2 Agricultural aircraft (137)

Regulation Flight Conducted Under

83 Regulation Flight Conducted Under
1 14 CFR 91 *(only)*
2 14 CFR 91D
3 14 CFR 103
4 14 CFR 105
5 14 CFR 121
6 14 CFR 125
7 14 CFR 127
8 14 CFR 133
9 14 CFR 135
10 14 CFR 137
11 14 CFR 129 *(Foreign flag)*
A Specify

Type of Flight Operation Conducted

(Complete 84a, b, c ***ONLY*** *if flight was a revenue operation conducted under 121, 125, 127, 129, 135)*

84a
1 Scheduled
2 Non-scheduled

84b
1 Domestic
2 International

84c
1 Passenger
2 Cargo
3 Passenger/cargo
4 Mail contract ONLY

(Complete 86 ***ONLY*** *if 84a, b, c is not applicable)*

86
1 Personal
2 Business
3 Instructional *(Including air carrier training)*
4 Executive/corporate
5 Aerial application
6 Aerial observation
7 Other work use
8 Public use
9 Ferry
10 Positioning
A Specify

First Pilot Information

87 Name *(Last, First, Initial)*
A Other

88 Pilot Certificate No.
A Other

89 Street Address
A Other

90 City
A Other

91 State

92 Date of Birth *(Nos. for M, D, Y)*
A Other

93 Age
Yrs
A Other

94 Sex
1 Male
2 Female

95 Seat Occupied
1 Left
2 Right
3 Center
4 Front
5 Rear
A Other

96 Principal Profession
1 Pilot—civilian
2 Pilot—military
3 Other—military
4 Aircraft mechanic
5 Business
6 Lawyer
7 Doctor/dentist
8 Police
9 Student
10 Clergy
11 Teacher
12 Engineer
13 Farmer/rancher
14 Retired
A Other

97 Certificate(s) *(Multiple entry)*
1 Student
2 Private
3 Commercial
4 Airline Transport
5 Flight instructor
6 Flight Engineer
7 Military
8 None
9 Foreign
A Other

NTSB Accident/Incident Number

National Transportation Safety Board

FACTUAL REPORT
AVIATION

First Pilot Information *(continued)* *(Multiple entry - blocks 98-102)*

98 Ratings—Airplane
1 ___ None
2 ___ Single engine land
3 ___ Multiengine land
4 ___ Single engine sea
5 ___ Multiengine sea

99 Rotorcraft/Glider/LTA
1 ___ None
2 ___ Helicopter
3 ___ Gyroplane
4 ___ Airship
5 ___ Free balloon
6 ___ Glider

100 Instrument Rating
1 ___ None
2 ___ Airplane
3 ___ Helicopter

101 Instructor Rating(s)
1 ___ None
2 ___ Airplane SE
3 ___ Airplane ME
4 ___ Helicopter
5 ___ Gyroplane
6 ___ Glider
7 ___ Instrument plane
8 ___ Instrument helicopter

102 Ground Instructor
1 ___ None
2 ___ Basic
3 ___ Advanced
4 ___ Instrument

103 Type Rating Endorsement This Aircraft
1 ___ Yes
2 ___ No *(Go to block 105*
A Other

104 Months Since Check/Endorsement This Aircraft
________ Months
A Other

105 Biennial Flight Review *(Or equivalent*
1 ___ Yes
2 ___ No
A Other

106 Months Since Last BFR
________ Months
A Other

107 BFR *(or equivalent)*
Aircraft Make/Model
A Make ________
B Model ________
C Other

108 Medical Certificate
1 ___ None
2 ___ Class 1
3 ___ Class 2
4 ___ Class 3
A Other

109 Medical Certificate Validity
1 ___ Valid medical—no waivers/limitations
2 ___ Valid medical—with waivers/limitations
3 ___ Non valid medical for this flight
4 ___ Expired
5 ___ No medical certificate
A Other

110 Date of Last Medical
(Nos. for M. D. Y)
____
A Other ________

111 Medical limitation
1 ___ None
2 ___ Vision
A Specify
____
B Other

112 Medical waiver
1 ___ None
2 ___ Vision
3 ___ Hearing
A Specify ________
B Other

113 Statement of Demonstrated Ability
1 ___ Yes
2 ___ No
A Other

114 Correcting Lenses *(Multiple entry*
1 ___ Not required
2 ___ Required to be in possession
3 ___ Required, not in possession
4 ___ Required to be worn
5 ___ Required, not worn
6 ___ Worn at time of accident
A Other

115 Source of Pilot Flight Time *(Multiple entry*
1 ___ Pilot log
2 ___ Company
3 ___ FAA
4 ___ Pilot/Operator Report
5 ___ Investigator's Estimate
6 ___ Relative
7 ___ Other Person
A Other

Flight Time	A All A/C	B This Make & Model	C Airplane Single Engine	D Airplane Multiengine	E Night	F Instrument Actual	G Instrument Simulated	H Rotorcraft	I Glider	J Lighter Than Air	K Other
125 Total Time											
126 Pilot in Command (PIC)											
127 Instructor											
128 This Make/Model											
129 Last 90 Days											
130 Last 30 Days											
131 Last 24 Hours											

132 Landings—Last 90 Days
All Aircraft
________ Day
A Other

133 Landings—Last 90 Days
All Aircraft
________ Night
A Other

134 Landings—Last 90 Days
This Make/Model
________ Day
A Other

135 Landings—Last 90 Days
This Make/Model
________ Night
A Other

136 Seatbelt Available
1 ___ Yes
2 ___ No
A Other

137 Seatbelt Used
1 ___ Yes
2 ___ No
A Other

138 Shoulder Harness Available
1 ___ Yes
2 ___ No
A Other

139 Shoulder Harness Used
1 ___ Yes
2 ___ No
A Other

140 Autopsy Performed *(This pilot*
1 ___ Yes
2 ___ No
A Other

141 Toxicology Performed *(This pilot)*
1 ___ Yes
2 ___ No
A Other

National Transportation Safety Board

FACTUAL REPORT
AVIATION

NTSB Accident/Incident Number

Pilot Information (continued)

142 Person at Controls
1 Pilot in command
2 Second pilot
3 Both pilots
4 Non-pilot
5 No one
A Other

143 Simulated Instrument Flight
1 Yes
2 No
A Other

144 Vision Restricting Device Used
1 Yes
2 No
A Other

145 Second Pilot
1 Yes *(Complete second pilot supplement)*
2 No

Flight Itinerary Information

155 Last Departure Point *(Multiple entry)*
1 Same as accident/incident location or
A Airport identifier
B City/Place
C State
D Other

156 Time of Departure
A Time
B Time Zone
C Other

157 Destination *(Multiple entry)*
1 Same as accident/incident location or
2 Local flight
A Airport identifier
B City/Place
C State
D Other

158 Flight Plan Filed *(Multiple entry)*
1 None
2 Visual Flight Rules (VFR)
3 Instrument Flight Rules (IFR)
4 VFR/IFR
5 Company (VFR)
6 Military (VFR)
A Other

159 Type of Clearance
1 None
2 VFR
3 Special VFR
4 IFR
5 Special IFR
6 VFR on top
7 Cruise
8 Traffic Advisory
9 VFR Flight Following
A Other

160 Airspace
1 Uncontrolled
2 Controlled
3 Airport traffic area
4 Control zone
5 Airport advisory area
6 Positive control area
7 Terminal control area
8 Stage II TRSA
9 Stage III TRSA
10 Prohibited area
11 Restricted area
12 Military Operating Area (MOA)
13 Student Jet Training Area
14 Demo Area
15 Warning area
16 FAR 93
(Special air traffic areas)
A Other

161 Control Area
1 None
2 Victor airway
3 Jet airway
4 Control airway
5 Colored airway
A Other

162 Route
1 None
2 Standard instrument departure
3 Standard terminal arrival
4 RNAV/OMEGA/LORAN/INS
5 Direct
6 Profile Descent
7 VR route (military)
8 IR route (military)
9 SR route (military)
10 Refueling route (military)
- Other

163 Last Two Way Communications Established
1 None
2 Yes
A Facility Identifier
B Other

Aircraft Loading Information

164 Fuel on Board at Takeoff *(Multiple entry)*
1 Estimated
2 Verified
A Gallons or
B Pounds
C Other

165 Fuel Types *(Multiple entry)*
1 80/87
2 100 low lead
3 100/130
4 115/145
5 Kerosene
6 JP 3, 4, 5, 6
7 Jet A
8 Jet B
9 Mixture
10 Automotive
11 Anti-ice additive added *(If known)*
A Other

166 Aircraft Weight at Takeoff *(Multiple entry)*
1 At or below max cert. gross takeoff weight
2 Above max certified gross takeoff weight
3 Estimated
4 Verified
A Other

167 Aircraft CG at Takeoff *(Multiple entry)*
1 Within limits
2 Exceeded fwd limit
3 Exceeded aft limit
4 Exceeded lateral limit
5 Estimated
6 Verified
A Other

168 Aircraft Weight at Accident *(Multiple entry)*
1 Same as takeoff
2 At or below max cert. gross takeoff weight
3 Above max certified gross takeoff weight
4 Estimated
5 Verified
A Other

169 Aircraft CG at Accident *(Multiple entry)*
1 Same as takeoff
2 Within limits
3 Exceeded fwd limit
4 Exceeded aft limit
5 Exceeded lateral limit
6 Estimated
7 Verified
A Other

National Transportation Safety Board

FACTUAL REPORT
AVIATION

NTSB Accident/Incident Number

Aircraft Loading Information *(continued)*

170 Load Description *(Multiple entry)*
1 None
2 Passengers
3 Cargo
4 Towing glider
5 Towing banner
6 Other external
7 Parachutists
8 Water
9 Chemical
10 Livestock
11 Illegal cargo
A Other

Weather Information

180 Source of Weather Briefing *(Multiple entry)*
1 No record of briefing *(Go to block 183)*
2 National Weather Service (NWS)
3 Flight Service Station
4 PATWAS (Pilot Automated Tel WX Answering Svc)
5 VRS (Voice Response System)
6 Company
7 Commercial weather service
8 TV/radio weather
9 Military
A Other

181 Method of Briefing *(Multiple entry)*
1 In person
2 Teletype
3 Telephone
4 Aircraft radio
5 TV/radio
A Other

182 Completeness of Weather briefing
1 Weather not pertinent
2 Full
3 Partial—limited by pilot
4 Partial—limited by briefer/forecaster
A Other

183 Investigator's Source of Weather Information
1 Pilot *(Go to block 185)*
2 Witness *(Go to block 185)*
3 Weather observation facility

184 Weather Observation Facility
A Identifier ______
B Time of observation ______ zone ______
C Elevation ______ feet MSL
D Distance from accident site ______ NM
E Direction from accident site ______ °magnetic

185 Basic Weather Conditions at Accident Site
1 Visual Meteorological Conditions (VMC)
2 Instrument Meteorological Conditions (IMC)
A Other

186 Conditions of Light
1 Dawn
2 Daylight
3 Night (Dark)
4 Night (Bright)
5 Dusk
A Other

187 Sky/Lowest/Cloud Condition
1 Clear
2 Scattered
3 Thin broken
4 Thin overcast
5 Partial obscuration
A ______ Feet AGL
B Other

188 Lowest Ceiling
1 None
2 Broken
3 Overcast
4 Obscured
A ______ Feet AGL
B Other

189 Visibility *(decimals)*
A ______ SM
B RVR ______ Feet
C RVV ______ SM
D Other

190 Temperature
______ ° F
A Other

191 Dew Point
______ ° F
A Other

192 Wind (From)
1 Variable
A ______ ° Magnetic
B Other

193 Wind Speed
1 Calm
2 Light and Variable
A ______ Kts.
B Other

194 Gusts
1 None
A ______ Kts.
B Other

195 Altimeter Setting
______ " Hg
A Other

196 Density Altitude
______ Feet
A Other

197 Restrictions to Visibility
1 None
2 Haze (H)
3 Dust (D)
4 Smoke (K)
5 Fog (F)
6 Ice fog (IF)
7 Ground fog (GF)
8 Blowing spray (BY)
9 Blowing dust (BD)
10 Blowing snow (BS)
11 Blowing sand (BN)
A Other

198 Type of Precipitation
1 None *(Go to block 200)*
2 Rain (R)
3 Snow (S)
4 Hail (A)
5 Rain showers (RW)
6 Freezing rain (ZR)
7 Snow shower (SW)
8 Drizzle (L)
9 Ice pellets (IP)
10 Snow pellets (SP)
11 Snow grains (SG)
12 Freezing drizzle (ZL)
13 Ice crystals (IC)
14 Ice pellet shower (IPW)
A Other

199 Intensity of Precipitation
1 Light
2 Moderate
3 Heavy
A Other

National Transportation Safety Board

FACTUAL REPORT
AVIATION

NTSB Accident/Incident Number

Accident Information

200 Aircraft Damage
1 None
2 Minor
3 Substantial
4 Destroyed

201 Aircraft Fire
1 None
2 In-flight
3 On ground
A Other

202 Explosion
1 None
2 In-flight
3 On ground
A Other

203 Damage to Property
1 None
2 Residence
3 Residential area
4 Commercial bldg
5 Vehicle(s)
6 Airport facility
7 Trees
8 Crops
9 Fence
10 Wires/poles
11 Other property

204 Injury Index *(Most critical injury)*
1 None 2 Minor 3 Serious 4 Fatal

Injury Summary *(Enter only one digit per block)*	A Fatal	B Serious	C Minor	D None	E Total
205 First Pilot					
206 Co-pilot					
207 Dual Student					
208 Check Pilot					
209 Flight Engineer					
210 Cabin Attendants					
211 Other Crew					
212 Passengers					
213 TOTAL ABOARD					
214 Other Aircraft					
215 Other Ground					
216 GRAND TOTAL					

217 Classification
1 U S Registered Aircraft on U S Soil, Territories and Possessions or International Waters
2 U S Registered Aircraft on Foreign Soil
3 U S Registered Aircraft operated by a Foreign Operator
4 Foreign Registered Aircraft on U S Soil, Territories or Possessions
5 Military Aircraft
6 Aircraft not Registered

220 Part Failure/Malfunction *(Multiple entry)*
1 None
2 Part/component #1
3 Part/component #2
4 Part/component #3
A Other ________

221 Incorrect Part *(Multiple entry)*
1 None
2 Part/component #1
3 Part/component #2
4 Part/component #3
A Other ________

	A Part/Component #1	B Part/Component #2	C Part/Component #3
222 Part Name			
223 ATA Code			
224 Manufacturer			
225 Mfg. Part #			
226 Mfg. Model #			
227 Serial #			
228 Part Condition			
229 Total Time			
230 TSO			
231 TSI			
232 Cycles Total			
233 Cycles Since Overhaul			
234 Cycles Since Inspection			
235 Service Difficulty Report or Malfunction/Defect Report Submitted	1 Yes 2 No	1 Yes 2 No	1 Yes 2 No
236 Bogus Part	1 Yes 2 No	1 Yes 2 No	1 Yes 2 No

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